THE

AMERICAN NATURALIST.

VOL. XXI. SEPTEMBER, 1887. No. 9.

SCIENTIFIC FACT AND SCIENTIFIC INFERENCE.

BY H. W. CONN, PH.D.

IT is the custom of scientists to regard their contributions to knowledge as the only ones concerning which there is any certainty. They point with pride to the many steps in advance taken by natural science within the last few centuries, and would compare this advance with what seems to them the stationary condition of non-scientific thought. The advances of science are thought to be sure, requiring no retracing, while non-scientific thought can be certain of nothing, one generation pulling down the structure of the last, only to put in its place an equally unstable conception. Metaphysics has scarcely reached a more certain position than it has held for centuries, for we still find schools and schools of metaphysics, each of which takes an entirely different view of nature. Theology is still divided into numerous beliefs, each bitterly opposed to the others. What little advance has been made our scientists think has been brought about through their discoveries, and they sometimes challenge the production of any positive advance in knowledge which has not been made through the instrumentality of science. Science, then, claims to be the only sure realm of knowledge, and claims that its truths, once established, are established for eternity. The scientific method has indeed been defined as one which accepts nothing without proof, in contradistinction to the unscientific method, which is willing to accept entire many theories and beliefs for which there is no proof and the meaning of which is unclear.

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Now, nothing is more plain than that science does *not* confine itself to demonstrated truth. It is easy to find in scientific publications hundreds of theories which have been advanced, defended, disputed, and rejected. Scientific literature is to-day filled with speculations and theories which are no more demonstrated than the most unreliable of non-scientific theories. Scarcely a publication appears that does not contain some new speculation, so that science is burdened with hundreds of unproved, unprovable hypotheses, making it as difficult sometimes to discover accepted truth of scientific teaching as to discover the accepted truth of those lines of thought which we call non-scientific. Yet in spite of this coming and going of hypotheses, or rather, as we shall see later, on account of it, the claim is still that science is the only sure thing, and its conclusions are the only ones that cannot be gainsaid. We find it almost universally recognized, not only among scientists, but among all thinking men, that if a universally-accepted scientific conclusion comes in conflict with any other, it is the scientific conclusion which stands and eventually modifies the other. If this authority for scientific facts is both consciously and unconsciously recognized, it must rest upon some foundation.

Absolute knowledge is, of course, impossible. No matter what we observe or prove, it is always open to the agnostic to deny all knowledge. We can never be certain that our minds are not utterly deceiving us, and that our mental processes are not in contradistinction to reality. We can never prove that the universe is intelligible, nor can we prove that the fact of our minds compelling us to assume nature to act in certain ways shows that nature does act in these ways. It is, of course, useless to attempt to demonstrate the truthfulness of nature or mind; and for this reason scientific observations and conclusions are open to doubt as well as all others. Fundamentally, no one thing is more certain than another, because a question as to the validity of thought affects everything alike. No advance is possible without the fundamental assumption of the truth of mind and nature. We must, then, always start with this assumption, and the question we are to consider becomes this: Assuming the truthfulness of mind and nature, are the conclusions which we call scientific any more likely to be correct than those which we call non-scientific? That they are almost universally so

regarded is certainly true. Let us, then, endeavor to find out upon what this claim for superiority rests.

It is frequently said that science's claim for authority is due to its dealing only with facts; but plainly this statement is far from expressing the truth. For, in the first place, all realms of knowledge deal with facts of some sort,—though facts relating to mind may be less cogent than those relating to physical nature,—and, in the second place, science is more than a collection of facts. A process of collecting and narrating facts is not science, for facts have no meaning except as they are compared together, and as conclusions are drawn from them. The significance of science, then, rests upon the deductions from the facts, and not upon the facts themselves. We must therefore carefully distinguish between scientific facts and scientific inference, and consider each in turn.

By scientific facts we mean simple matters of observation, such as that a given stone drops to the ground. In regard to them there can be no doubt that they are everywhere regarded as the most certain factors of knowledge. This certainty seems to rest upon two things,—Firstly, scientific facts themselves are of such a character that they cannot be modified by man nor changed by his imagination. They are beyond the reach of human influence, and we are forced to accept them as true. Now, this cannot be said of the data of other realms of knowledge. We clearly recognize that minds are unlike, and that people think very differently upon the same subject. Some men even deny that there is a right and wrong, or would change the word right for expediency. When a subject such as metaphysics rests upon the introspection of mind alone, it is evident that the personal factor is a large one. Nothing is, perhaps, more certain than the primary laws of thought, and we must assume that, if freed from personal idiosyncrasies, all minds would think alike. But thinkers have not yet been able thus to free themselves; and when it comes to the application of the laws of thought, either the difficulty of the application or the personal factor of the individual becomes so great that contradictory results are reached and the certainty, of course, destroyed. We see from this that mind is open to error, which must be recognized as affecting all but the simplest laws of thought. Mental processes, mental perceptions, mental activities in general, are open to vari-

ation in different persons; but we are confident that the facts of nature are alike for every one, and are therefore more to be trusted than anything open to individual variation. But, secondly and primarily, the certainty of scientific facts rests upon the recognition that they need not be accepted as matters of evidence simply, but are of such a nature that they can be repeated and again observed. It is possible to perform a scientific experiment as many times as desired, and with the same results. If any one doubts the results, they can be proved to him by making him observe them. While practically all observations must be given on matters of evidence, nothing rests ultimately upon evidence, for there is always the possibility of repetition and verification. Upon this consideration rests primarily our confidence in the facts of science; and this, again, is a source of certainty not possible except in natural science. History approaches more closely to science in its certainty than anything else. A scientific fact is in itself, of course, no more sure than a fact of history, in so far as each rests upon the same evidence, and the evidence may become sufficient to establish historical facts with absolutely convincing force. But we can never repeat facts of history; it must depend entirely upon evidence, which becomes less certain as it becomes less in amount, and consequently as we get farther away from the facts. Nor can we ever be sure of repeating mental conceptions. We can never know that we are following another person's thoughts, or that we are putting ourselves into the same mental position which he holds. We cannot be certain, then, that we are performing the same mental processes, and therefore repeating his thoughts. In so far, then, as scientific facts depend upon evidence, they have the same force as facts of history. In so far as they imply mental processes in observation, they are open to the same sources of personal error as all other mental actions. But when they can by repetition be made a perpetual source of evidence to each individual, and when we realize that they are matters of observation and not of interpretation, and therefore personal idiosyncrasies are almost entirely eliminated, we must look upon scientific facts as more certain than all others, and, indeed, as approaching the condition of absolute certainty.

But this is only the beginning of the matter. If science contented herself with facts her position would be unassailable, but

worthless. We sometimes hear it said that science should stop with facts, and that it has no right to draw conclusions; but this is plainly both impossible and undesirable. A science made up of facts, no matter how true they might be, would be meaningless. Simple observations, however numerous, no more constitute science than a lot of numbers shaken up in a basket would constitute mathematics. It is only as the facts are classified, as generalizations are made, as inferences are drawn from them, and conclusions reached, that observations begin to have any significance. It is a meaningless fact that the Silurian rocks are under the Devonian, but it becomes pregnant with meaning when we draw the inference that this indicates a relative age of the rocks and fossils in them. It is utterly valueless to us to know that a thousand stones which we have observed fell to the ground, but it is of the utmost importance when we draw from the observations the conclusion that all heavy bodies tend to fall towards the earth, and of even more significance when we conclude that all bodies tend to fall towards each other. In these simple cases the conclusions seem almost included in the observations, but, nevertheless, they are entirely distinct from them; and this serves to illustrate the statement just made, that it is only inferences and conclusions which are of any significance. If, then, science uses its observed facts only as data for inferences, and is itself a collection of deductions, is it any more deserving of credence than other branches of learning? Plainly enough, there is no longer either of the special reasons for acceptance which we have seen giving superior value to scientific facts. The inferences here are just as truly open to the error of the personal equation as they are in any other line of knowledge, and there is primarily no reason for thinking them better drawn in science than elsewhere. Is there, then, any reason for thinking that scientific conclusions are especially deserving of credence, and have a right to the claim which scientists hold for them,—of being the most certain conclusions of knowledge? That the usual answer to this question will be in the affirmative seems quite certain. Scientific conclusions are everywhere received as authoritative. They have driven other branches of learning from many of their positions, and have not in turn been driven. The most serious argument which can be urged against any belief is that it contradicts the conclusions of science, and it

is everywhere recognized that our theological and metaphysical beliefs must agree with the accepted conclusions from science.

But no sweeping statements can be made. Scientific inferences have a very varying degree of probability, ranging from almost certainty to the wildest hypothesis. Proof of an inductive conclusion is an impossibility, for it must not only be shown that the conclusion in question fits all the facts of the past, present, and future, but also that it is the only conclusion that can possibly be framed to fit the facts. This is a manifest impossibility; but the approximation to it may be very close. Most persons would regard the circulation of the blood as a demonstrated fact, and yet it has never been observed nor absolutely demonstrated. It is an inference from observed facts, but an inference so strong that it is utterly impossible to doubt its being the truth. From practical certainty like this we may pass by easy stages to the wildest hypothesis. The law of gravitation; the theory of the long duration of the geological ages; the theory of evolution; the theory of the spontaneous generation of life, either at the present time or in the past; the idea of a central sun around which all the stars in the universe are revolving,—all of these represent inferences from scientific facts, but inferences of a less and less degree of cogency of proof, until the last is nothing more than a poetical speculation. Recognizing thus the varying degree of probability, it is plain enough that it is impossible to make the general statement that scientific conclusions are of any more value than those from non-scientific thought. Nor, indeed, would our scientists pretend that such a statement could be made, for, however firmly they may believe in the cogency of their conclusions, they are fully aware of the possibility of false inferences and mistaken theories.

How is it, then, that scientific conclusions can have any superior authority? The answer is, because they are, in most cases, open to a more or less direct verification, and the force with which they appeal to us is directly proportioned to the exactness of this verification. It is frequently possible, by appealing to facts of observation (which we have seen are our most sure source of information), to render an inference palpably absurd, or to show it in most exact accord with all nature. In the first place, our scientists are constantly dealing with facts. They begin their training by observation, and for a long time observa-

tion occupies almost their sole attention. Many, indeed, get no farther than this, and are little more than observing machines. When they do go outside this line it is always with more or less caution, because they well know that if their inferences be not truths they will soon be disproved. Trained to deal with facts, they are constantly using observation as checks and guides to their speculation, and after any conclusion is reached or any theory made it must meet thousands of unthought-of observations from nature, and be found to fall in with them all in perfect harmony before it can stand as an accepted scientific conclusion. In this they differ from metaphysical or philosophical inferences. If one theologian differs from another, each can think the other mistaken without the possibility of proof, for the necessary facts are beyond their reach, and the different stand-points of the two give, each, a different view. But if one scientist differs from another, it is frequently only a matter of a few years when further collections from nature's store of facts will refute the position of one, or perhaps both. Here, then, there is a possibility of verifying the realm of thought by the realm of fact. Observations are made, and the mind works them over and draws conclusions from them, creating usually a thought to explain them. Then once more it turns to observations to see if the thought created for a few facts will explain all, and thus have the force of a general truth. When Darwin first conceived the theory which afterwards made his name famous, it was from a few observations upon the geographical distribution of animals; but, having conceived a thought which explained these facts, he spent twenty years in patient application of this thought to all other classes of observation, and it was not till he had satisfied himself that the conclusion did harmonize with all the facts which he could collect that he was ready to let it be known. When the theory was finally given to the world its great force was in this very fact, that it was shown to be in such accord with numerous facts of nature; and what prevents it from being universally accepted to-day is that there are still some facts which do not seem in accordance with the theory.

Thus it is with all scientific theories which have any authority. There is always a world of observation to be considered, which must be found in harmony with the conclusions. So cogent do these conclusions sometimes become that they not only enable

us to interpret the present and explain the past, but to predict the future. In every way they may thus be made to show their exact harmony with nature. False inferences cannot be in harmony with this truth, and errors cannot stand. Scientific theories are very abundant, and many of them are wrong, but the world of facts gives an opportunity for examination, dispute, and final rejection of the false ones. This fact, that many theories have been disproved and rejected by those who originally advanced them, is the greatest safeguard of science, for it gives us the greater confidence in such conclusions as retain the universal acceptance of thinkers after long discussion.

In this way it is that scientific conclusions may, under the right conditions, appeal to us with such force. Such a verification is impossible in other branches of learning. There are no similar series of observations which can be brought to testify to the truth of metaphysical or ethical conclusions. Here each conclusion can be attested only by the same sort of evidence which produced it. It is, in all stages, a mental conception, for which there can be no physical evidence. The errors which may have crept into the original inference cannot be removed by contact with reality. The personal equation becomes great, and hopes, desires, loves, and enmities may come in to modify that equation. A person brought up as a Mohammedan believes Mohammedanism beyond dispute, while we are even more confident of the truth of Christian beliefs. Two races of people, if kept separate from each other, might develop different systems of theology, of metaphysics, of art, of morals, because these would depend almost entirely upon the thinker; but the laws of dynamics, the classification of the animal kingdom, would be alike in both cases, for these depend not upon the thinker alone, but are verified by nature.

Assuming, then, the general truthfulness of nature and the validity of mind, there is a general concession that there is a greater certainty possible for scientific inferences than for others. A greater certainty *is possible*, but it does not always exist, nor does it extend to all scientific theories. Because a universally-accepted theory claims so great credence it by no means follows that all science deserves a similar acceptance. Here it is that scientists make their greatest mistake, in failing to separate the positive from the probable and the possible. The conclusion

that the fossils of our rocks were once living animals occupies a very different position from the theory of evolution. One is almost included in the observed facts, while the other implies much more of inference. But too often our writers and teachers fail to separate them, giving equal credence to such theories as the undulatory theory of light and the law of gravitation. This is all very well when scientist is addressing scientist; any amount of imagination and speculation is then admissible. Hypothesis may be assumed as fact, and used as a basis of further conclusion. But a teacher to his students or a writer to the general public should be very careful to distinguish between the positive, the probable, and the possible. He should offer as positive only such conclusions as have placed themselves beyond dispute, and regard all others as more or less probable, according as they have been verified by observation. Unfortunately, many of our teachers, and an even greater number of our writers, fail to do this. They are ready to accept before the public more than is proved, as it is perfectly proper for them to do with each other, and they thus lose the reputation for exactness and unwillingness to accept anything that is not beyond doubt, which should always characterize science.

A scientific fact, then, claims superiority to all else for two reasons,—the necessary belief in the truthfulness of nature, and the possibility of indefinite repetition of experiments and observations. But when we go beyond the facts and draw inferences, there is primarily no more reason for believing in the truth of the inference from science than in any non-scientific inference. Some conclusions can, by a long and successful verification from the facts of nature, be rendered very certain,—more certain, indeed, than any other factor of knowledge. We, then, frequently call them facts, though they are really nothing more than strong inferences. But this does not in the least give any greater probability to other conclusions. The fact that a theory is a scientific theory tells us nothing as to its probability, for there are many conclusions of theology or morals more probable than certain scientific conclusions. It is only after a conclusion has long stood the test of fact, and has shown itself so in harmony with all nature as to be universally accepted, that there can be claimed for it any of that superior weight of authority which is by general consent given to scientific truths.

COMPARATIVE CHEMISTRY OF HIGHER AND LOWER PLANTS.

BY HELEN C. DE S. ABBOTT.

(Concluded from page 730.)

THE laws controlling the chemical evolution of plant-constituents are too little comprehended to formulate, but before reaching a position evèr to do this, it will be necessary to study carefully the facts from extended researches, to ascertain how these chemical constituents occur, under what conditions, and if these conditions are constant or variable, and to what may be ascribed the variability.

In speaking of chemical compounds I will describe them as occurring according to the botanical disposition of Heckel's table, which I use provisionally, since it is not probable that this presentation will be the ultimate or best way to introduce the subject. But I am not prepared yet to offer any other arrangement purely on a chemical basis; since the application of the chemical side of plant-life as one more evidence in favor of the hypothesis of evolution, is still too new to possess a literature of its own.

I have already referred to the protoplasm and starch, also to the large ash-percentages of some of the lower groups, and among the compounds commonly found in many plants tannin appears first according to the evolutionary order in liverworts.

Chlorophyll is one of the earliest compounds to appear, and its presence in Algæ and its absence in Fungi is a distinction between the two divisions of the Thallophyta group. Besides this green coloring matter, which is, with few exceptions, common to all plants, other brilliant coloring matters occur in some of these lower plant forms which are peculiar to whole families and correlated with special physiological functions.

The general distribution of chlorophyll, with few exceptions, in all plant groups is only second to the proteid compounds; however, the color of this compound is not the same tint in all plants, and the evergreens and many other plants when compared will be found in this respect distinct. The gradual change from the bright greens of the early spring foliage to the duller greens

of late summer illustrates the transmutation of color which may be observed in plants, and I would suggest that this same gradation may be seen on the large evolutionary planes of all plant groups, chlorophyll, like the plants, being at different evolutionary stages; for example, in many Algæ and lower plants it appears as light bright greens, and finally in the darker greens of the higher plants.

Considering in general the chemical compounds of flowering plants among the apetals and monocotyledons on the first evolutionary plane, where the plant elements are simple, tannin, wax, starch, aromatic or acrid principles, and the oils and sugar of the palm are the most conspicuous substances. These compounds are found in the same or in neighboring plants, and their association is doubtless of evolutionary significance. Glucosides or alkaloids, though occurring in some few of these plants, are not characteristic of this stage of evolution.

Tannin is a general name for a class of substances which presents many aspects in different plants. It first appears, as was stated, in the liverworts, combined with large quantities of starch and wax; then in ferns. Among the amental apetalous groups it is one of the conspicuous compounds, also associated with starch; the casuarina, willow, poplar, hazel, oak, beech, chestnut, alder, and birch containing large quantities. Tannin is widely distributed, though especially in the leaves, barks,[1] seeds, and rinds of fruits, and in other plants in considerable quantities, as the maple, sumach, tea, in many berries, the holly, and the seeds and stalks of the grape-vine.

Tormentilla erecta,[2] Rosaceæ, yields six to twenty per cent tannin, and, although this compound is present in mono- and dicotyledonous plants, it seems to be more prominent in the apetalous on the first evolutionary plane, and to occur less, if at all, in the highest plants. When it is remembered that tannin is found in greater abundance in lower plants, which I have compared as formative to the formed or higher evolutionary groups, it is a still further illustration of what was stated about the higher percentage of ash-constituents in lower plants.

Physiologists differ as to the tannin functions in plants. It

[1] "Repartition du Tannin dans les diverses Regions du Bois de Chene," Ann. de la Science Agr.

[2] Fraas, Ergebnisse, Landw. Versuche, München, 1861.

probably serves several purposes; according to Schell, as a plastic material for the building up of tissues, especially where starch or fats are absent; or it exists as a subordinate product. It is certainly true that some tannins play a distinct rôle as the source of many vegetable colors,—the reds and blues of flowers, the brown of tree-barks, and the colors of changing leaves owing their origin to this source.

The large quantity of starch in most tannin plants is remarkable, and Sachs believes it, or fixed oils, to be the mother-substance of tannin.

Datiscin,[1] a kind of starch, is found in the Datisca order, and, among the monocotyledons, the palms occur on the same plane, and in most of their genera contain large quantities of starch, eight hundred pounds of sago having been obtained from one plant of *Metroxylon*, or the sago-palm species. The *Arum pandanus* (screw-pine) and bulrush orders yield much starch; of the latter plants, 12.5 per cent. from *Typha latifolia* (Lecoq).

Large quantities of wax are found in species of the myrtle, and also of the palm.

On the second plane, or multiplicity of floral parts, the chemical constituents become much more numerous at this stage. Under the apetalous and monocotyledonous groups volatile, pungent, and aromatic principles, alkaloids, sugars, coloring-matters, camphors, resins, starch, and glucosides appear prominently. The lower dicotyledonous plants reproduce many of the compounds of the other two classes, for the Rosaceæ contain the tannins of the lower apetalous plants and its parallel groups, and the glucosides of the higher monocotyledons.

Cane-sugar is a prominent compound here. If a horizontal line be drawn from a given point of Heckel's scheme it passes through the apetalous, mono- and dicotyledonous groups, which contain this substance most abundantly,—namely, the sugar-beet, sugar-cane, sorghum, the fruit groups of the Rosaceæ, and the sugar-maple.

The sugar of the palms, among the highest of plants with simplicity of floral elements, is very like that of the cane. Since the grasses are the lower of monocotyledons with multiplicity of parts, it is notable that at the meeting-ground between these groups, or at the transition-stage into multiplicity, sugar should

[1] According to Stenhouse, datiscin is a crystalline glucosidal bitter substance.

occur. The sugar of the palm is very little above the sugar line; it may be considered, in an evolutionary sense, as passing to the cane-sugar of these other groups, and as forming the apex of a low triangle, the base being the sugar line already described. The large percentage of grape-sugar in the fig, *Ficus carica*, occurs in a class very nearly on a line with these cane-sugar plants.

Glucosides are more especially the compounds of the middle plane of plant development, and are found in the higher monocotyledons of this stage, in the lower and some of the higher dicotyledons, and less frequently in the highest of all plants, or under cephalization. The first appearance of a glucoside occurs in the apetalous groups of flowering plants, as quercitrin in *Carya tomentosa*, Juglandaceæ, or in other hickory varieties; then in the next following orders, as salicin and populin, of the willow and poplar; antiarin, of the Antsjar, or Upas-tree (*Antiaris toxicaria*); acorin, of the *Arum;* and coniferin, of the Coniferæ. Among the Lirioideæ groups many glucosides occur, especially saponin, and I have found this compound in species of the yucca, agave, and among dicotyledons in leguminous plants; besides, it is found in Rosæ and other parallel groups.

Saponin is also found in *Smilax*, a genus partaking somewhat of the nature of endogens and exogens, and serves to unite all the saponin groups;[1] and although this compound is widely distributed in plants, it is a significant fact that all the groups containing it belong to this middle evolutionary division.

Rosoll[2] has found saponin in the cell-sap of living roots of *Saponaria* and *Gysophila*, and I have elsewhere called attention to the solvent action of saponin on resins,[3] also on calcium oxalate. This property is of value to the plant not only by acting as a solvent of insoluble or slightly soluble compounds, and thus assisting it in obtaining food otherwise difficult of access, but also resins are found in nearly all the Lirioideæ, and the presence of this chemical class associated with saponin shows a physiological adaptation of importance to the plant. It may be recalled that the pink family is remarkable for its proportion of lime, and this element is frequently found in large quantities,

[1] "Chemical Basis of Plant Forms."

[2] Monatsb. Chem., v. 94; Jahresb. d. Chem., 1884.

[3] *Yucca angustifolia*, Trans. Amer. Phila. Soc.; Chemical Basis of Plant Forms, Jour. Franklin Institute.

as well as resins, in other saponin orders. Saponin may thus be called a constructive element in developing the plant from the multiplicity of floral element to cephalization of these organs.

Among the members of the higher groups of plants many of the preceding stages of chemical evolution are represented up to a certain point, when the plants acquire other chemical characteristics,—*i.e.*, indigo, hæmatoxylin, and other coloring-matters of the leguminous groups, and the dyes of the madder plant, give way to the alkaloids of the cinchona, the coffee, the atropa, and the strychnos orders, and to the organic acids of the valerian order, and the aromatic and volatile compounds of the Compositæ.

Alkaloids, though so widely distributed, are not found in the very lowest nor the highest plants. Their occurrence in fungi has been already noted. In flowering plants among the lower apetals, piperin, the alkaloid of Piperaceæ, occurs; also, alkaloids are found in the monimia, hemp, laurel, and amaryllis orders, and in colchicum; but they are exceptional in these lower groups, and belong properly to dicotyledons, where they are found in many orders.

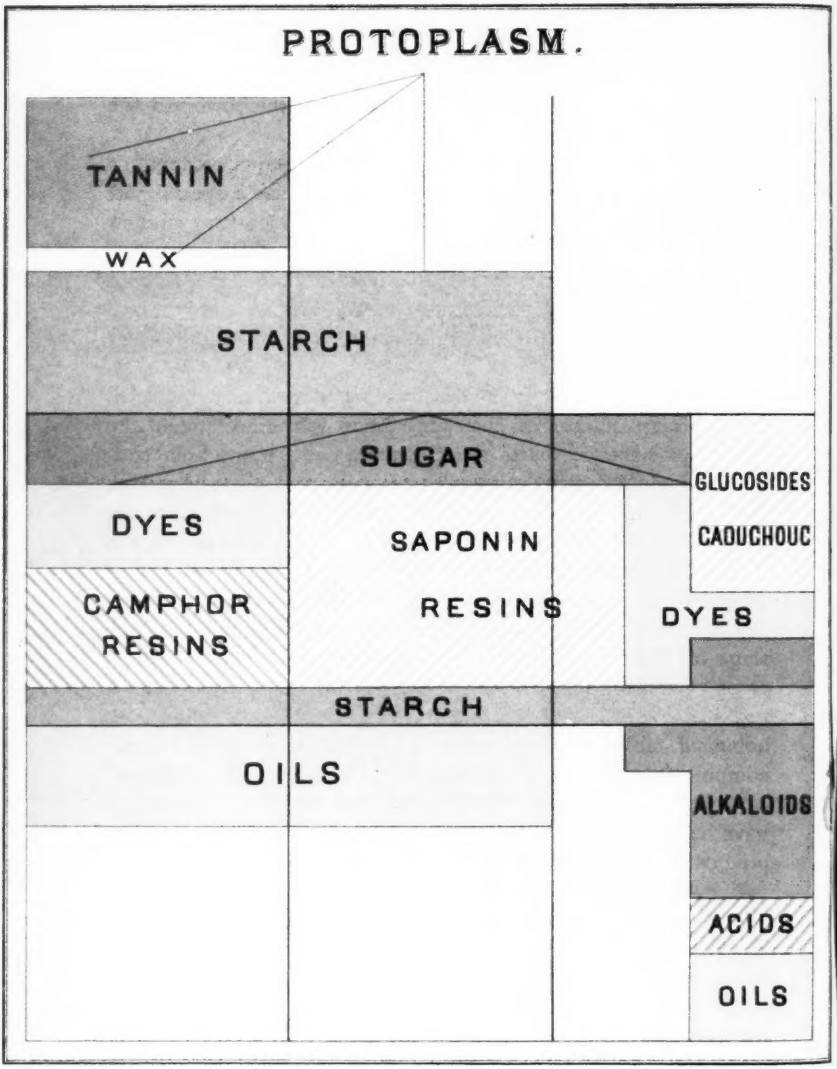
Besides the occurrence of compounds peculiar to distinct plants or whole plant groups, another class is found, and the substances of this class may be scattered quite generally through the plant kingdom, but always associated with some other compound.

Coumarin, the odorous principle of tonka-bean and vernal grass, is one illustration; its occurrence is limited to those plants containing oils, and, since in many genera in which this substance has been found certain fixed or ethereal oils also occur, it may be inferred that this constancy relates to their chemical evolution. The palms are the lowest plants which contain coumarin; then it occurs in the grass and rose families on the same evolutionary plane, also among the leguminous, madder, rue, and portulaca orders, and in orchids and Compositæ. These plants are characterized by their aromatic and volatile oily products; and vanillin, the fragrant principle of vanilla, also occurs among orchids. It may be noted that oils are formed abundantly in the highest plants.

A knowledge of the chemical compounds, as they are found grouped in plants, is a first step towards the study of their evo-

PLATE XXVII.

Plate II.



lution, and acquaintance with the conditions which control their synthesis and gradual formation in the plant can only be had by patient research. The simpler compounds of which any complex substance is built, if located as compounds of lower plants, would indicate the lines of progression from the lower to the higher groups.

It has been already said that every plant contains compounds peculiar to it, but certain compounds seem to play a special part in plant evolution, since the wax and tannin of the vascular cryptogams lead to the tannin and wax groups of the apetalous plants, and the starch of these lower plants to the great starch groups of the monocotyledonous. It will not be out of place to note here that the greatest accumulations of starch occur in plant orders just before they pass on to a higher plane of evolution. This is seen, for example, in the palm and neighboring orders of the first plane, and among the Lirioideæ of the second plane, since these plants are the richest in starch constituents, and it seems as if they were preparing by large reserves of food-supply for their higher position, represented by more evolved groups, where the demands for nutrition are greater. Again, the line of cane-sugar indicates that sugar occurs prominently in plants passing from simplicity to multiplicity of floral elements, and the glucosides in their turn are found in the middle stage of plant development, assisting the plants to the highest plane of cephalization.

Plate XXVII. is a chemical representation, drawn after Heckel's botanical table, and from what has preceded it will be easily comprehended. It is not to be inferred that all classes of chemical compounds found in plants are represented, since only a few have been used for illustration, nor that all of these given compounds only occur in the designated plant groups, since they may occur in traces or varying quantities elsewhere. However, these compounds are conspicuous as being especially typical of the plant groups which correspond to their location, and where their presence is doubtless associated with the plants' evolution.

The chemical compounds which may be said to be typical of an order, species, or an individual member of a series would be out of place in this general presentation.

Some plant groups, as the Proteaceæ, orchids, and Compositæ, develop in æsthetic beauty at the expense of their chemical con-

stituents, all resources go to develop the perfection of the flower, and the absence of numerous compounds in these plants is a strong point in favor of chemical evolution favoring plant development. These beautiful plants being among the highest of their series, may well be called the aristocrats of the vegetable kingdom.

It is still impossible to demonstrate the full significance of this chemical theory in plant development, but it will be evident to any one who examines botanical and chemical facts that the presence of certain chemical compounds is associated with certain botanical conditions, and where these conditions are variable, is found a like variability of chemical composition. If it can be proved that chemical and botanical morphology are not one and the same, at least the two are very intimately correlated.

It has been said that many of the constituents found in plants are the result of destructive metabolism, and are of no further use in the plant's economy, but our knowledge of what constitute plastic and waste products is by no means settled, and even should we be forced to accept the conclusion that some products are of no use to the plant, yet it is a significant fact that certain cell-tissues or organs secrete or excrete chemical compounds peculiar to them, and which are only to be found in one family, or in species closely allied to it.

Broadly speaking, the study of plant-life cannot be confined within the limits of the vegetable-cell, since its radiations reach to the domains of mineralogy and animal life. From a chemical point alone it would be difficult to discriminate in every case between the plant- and animal-cell. The series of animal-gums, carbo-hydrates, alkaloids, and coloring-matters find their analogous series in plants; by the study of embryology it is found that alantoin occurs in animal- and plant-life, also glycogen and inosite are found in both kingdoms, and the secretion of some plant-leaves is a fluid chemically like the animal gastric juice.

M. Leo Errera,[1] in a recent paper on a fundamental condition of equilibrium of living cells, calls attention to the thin and plastic condition of plant- as well as animal-cells at the moment of their formation, and their tendency to assume a form which, under the same conditions, an imponderable lamina of liquid would take, and he attributes to this fact their adaptability and the facility

[1] Comp. Rend., t. xiii., 1886, p. 822.

with which they change. He believes that we can trace to this cause the great number of organic forms, and for the first time unite the architecture of the cell to molecular physics. Only with age the cell-membrane becomes thick and offers a considerable resistance.

It may be suggested that this fact is further exhibited when applied to the conditions obtained when plants pass from their younger to older stages; again, it is seen on comparing the lower plastic protoplasmic plants with the rigidity and firmness of the tissues of the higher plants, and in the change from the semi-fluid to the formed and fixed states of chemical compounds.

The law of progression is one that regards the general good to the disregard of the individual; since in the death or fixation and crystallization of individuals the vegetable kingdom, on the whole, has ascended to its highest present living form, and many of its constituent chemical parts had long ago reached their pinnacle in the cycle of evolution. This concerns equally the changes in the vegetable-cell, and its complex molecule of proteid is built from simple substances, which in turn break down into less complex bodies, and are again reconstructed into proteids, or as cellulose and other compounds remain as the component parts of tissue in higher plants, thus serving the mechanical and physiological needs of the organism.

Aside from the practical application of plant products to dietetics, pharmacy, and the industries, it is eminently for purposes of scientific investigation that the field of plant chemistry is most promising.

It has been suggested to me from botanical sources that time will be unwisely expended over a detailed study of the chemical compounds of plants; in this, as in mineralogy, its use as a means of classification will depend upon the convictions of the investigator, although it seems to me that many of the vexed questions of plant development can only be solved by a full comprehension of vegetable chemistry.

It is not to be inferred that "botanists," the knights of morphology and systematic classification, will thereby be deprived, by chemists, from tilting over the floral tournament courts. Perhaps in such pleasant pastimes of contest for disputed plant groups this veteran army of knights-errant may at least become weary, and willingly exchange the lance for the balance.

The vegetable kingdom is so vast that the botanico-chemical facts at our disposal are meagre in comparison to the data required, and in consequence many of the explanatory statements advanced can only be considered in the light of speculation. Vistas have opened most promisingly but to be cut off suddenly by a limitation of these details, and I cannot urge too strongly the very great importance of minute chemical research at least in certain typical members of botanical groups; without such investigation a great deal of our present knowledge is worthless. The changes of the chemical compounds within the cell, the simultaneous appearance of two or more compounds always in association, and the predominance of some one compound in certain plant groups, should be seriously considered before the evolution of plant chemistry be definitely approved or condemned. These facts suggest questions which must be answered before a further advance can be made in plant biology.

The practical application of a theory, which advocates that the morphology of a plant is the outcome of its chemistry, will be used by the chemist to direct him to certain plant groups for any compound which experience proves to be present with similar morphological characters in other groups.

It has been recently suggested[1] that many of the chemical compounds may serve the plant as means of defence against animals, and when we camphorize our furniture and poison our flower-beds, we are only imitating and reinventing what the plants practised before the existence of man; and I may add that the cinchona-tree of malarial countries proclaimed long since their subtle therapeutical skill in securing for themselves a corner in quinine manufacture, independent of contemporary sources.

A full acquaintance with the chemical compounds of living plant orders may even lead to a chemistry of paleo-botany, and where the fossil forms resemble modern groups, as in some of the well-preserved remains lately discovered in France,[2] the same chemical compounds might have existed as are now found in similar groups. From the knowledge which will one day be ours of the morphology and evolution of chemical substances, a flora may be reconstructed reaching far back into the recesses of time.

[1] M. Léo. Errera, Royal Bot. Soc. of Belgium, Revue Scien., 29th Jan., 1887.
[2] M. Louis Crié, Comp. Rend., t. ciii. p. 1143.

In minerals, plants, and animals the same principles recur, though at each higher plane under more complicated conditions; and any one who, on visiting the Hot Springs of the Yellowstone National Park, has seen the non-carboniferous gelatinous masses assuming the forms of organized life will ask himself if silica, under some conditions, may not replace carbon and become living matter. Since Confervæ do live in these springs at high temperature, perhaps some such locality as the Yellowstone may have been the birthplace of "a protoplasmic primordial atomic globule."

The impulse which directs minerals to masquerade as living plants and animals often manifests itself, for example, in the ferns called stag-horns; and orchids, disguised like insects, pretend to be what they are not. When will all of these intricacies of nature's secrets belong to commonplace facts? The day is distant. And in the mean time my hour is drawing to a close; and, to return to my first statement of the evolution of the chemical elements, I would say that the studies[1] of Lecoq de Boisbaudron, Auer, Demarçay, and Crookes on didymium, and the latter's researches on yttria, and more recently on the crimson line of phosphorescent alumina,[2] go to show that the molecules of these so-called elements are compound, and if I have dwelt at all upon this subject, in connection with plant-life, it is on account of the indisputably serious nature of the investigations in this field. On listening to the following concluding remarks of Professor Crookes's address[3] the chemical evolution of plant compounds receives an able ally. He says, "We cannot venture to assert positively that our so-called elements have been evolved from one primordial matter, but we may contend that the balance of evidence . . . fairly weighs in favor of this speculation. . . . The doctrine of evolution, as you well know, has thrown a new light upon and given a new impulse to every department of biology, leading us, may we not hope, to anticipate a corresponding wakening light in the domain of chemistry. I would ask investigators not necessarily either to accept or reject the hypothesis of chemical evolution, but to treat it as a provisional hypothesis; keep it in view in their researches, to inquire how

[1] Comp. Rend., t. civ., 1887, p. 165, M. Henri Besquerel.
[2] Chem. News, Jan. 21, 1887.
[3] Delivered before the British A. A. S., 1886.

far it lends itself to the interpretation of the phenomena observed, and to test experimentally every line of thought which points in this direction."

From the above sketch I have attempted to show that the hypothesis of evolution may also apply to the chemistry of plant compounds, and that plant chemistry will be found, like any special study, to include many others. It is, however, exceptional in its broad range, and the variety of its topics, like the variations of flower-species, may be cultivated to suit the taste of the investigator.

INSTRUCTION IN GEOLOGICAL INVESTIGATION.

BY WILLIAM MORRIS DAVIS.

Revised from a paper read before the Association of American Naturalists in Philadelphia, December, 1886.

INSTRUCTION in geological investigation is so new a department of teaching that it is little assisted or hampered by traditional methods. Its best materials are found in the wide out-door laboratory, and as all out-door laboratories are of their own local kind, every teacher is required to develop his own methods of using them; and he must count this to his advantage, for it prevents him from doing his own work in some other person's way. The personality of the teacher must appear here if anywhere; and it must be strongly flavored with the local problems that spring up around him in new crops every year, and with his own methods of attacking them. Instruction in geological investigation at any one place cannot therefore hope to reach the completeness that may be attained in physics or chemistry, where experiments are made to order in-doors, limited rather by the funds than by the place of the laboratory. Consequently, one of the first aims of the instructor, and of the student too if he take a proper share in laying out his own course of work, should be to see that his geological studies are pursued under more than one teacher and in many more than one place. So distinct is this need, and so strong do I feel the limitations that determine it, that I shall not presume to talk up to the general title suggested by the committee in charge of our meeting, but shall at

once make my statements specific and tell you little more than my own plan and practice of instruction in this broad subject. Neither plan nor practice has much age to recommend it; both vary, to their improvement I trust, from year to year; and it should be explained at the beginning that my experience does not reach to either one of two branches of geological study that occupy much attention,—palæontology and petrography: there is enough to begin with in structural and physical geology.

Investigation begins with learning to see for oneself. The first teaching in geological investigation should therefore be made early in the course of study, and not postponed so that only advanced students and specialists can reach it. College sophomores, having had a general lecture course on geology in their freshman year, are well prepared for the first steps; but they are truly first steps that are then taken, for the face of the country has no expression to young men who have indeed learned what is considered the saving quantity of classics, mathematics or history, but who are unpractised in observation; their eyes are not yet opened to the sight of the land about them. Sometimes, to be sure, a student comes bringing with him the popular impression that he is something of a geologist because he can give the specific names of a number of minerals and fossils, learned in a cabinet; and he may be excused for thinking so, for does not every geologist meet, during his summer travels, the embarrassing necessity of simulating an interest in the kind attentions of his host who wishes to exhibit some "curious mineral" or "fossil footprint," as if the geological attractions of the neighborhood centred therein? The mental philosophy of geology is still an unopened book even to intelligent people. Naturally enough, therefore, the student, who has imbibed the popular conception of the study, or who has learned only from books and lectures a series of verbal definitions and explanations, comes to a full stop on being told that he is to discover for himself and from his own observation the correlation and sequence of geological phenomena in the district around him. The fundamental difficulty that he feels is the inability to see what he looks at. When this difficulty is fairly overcome, the gain that he has made is of so great value in his general as well as in his geological education that I find in this very fact the warrant for the election of the study of field geology by many more young men than the

few who may intend to follow the subject professionally in later years. Let us consider an actual case. The first excursion that I commonly take with a class leads us to an old quarry in Somerville, near the Agassiz Museum in Cambridge, where a large dike, some forty feet wide, cuts across the beds of the Somerville slates. There may be ten or twenty students in the party, and it should be remembered that they have had a preliminary course in elementary geology, in which nearly all the terms that we have occasion to use have been defined: they are also provided with hammers, compasses, clinometers, note-books, and outline maps of the district. On entering the quarry, I select two fragments of rock: one exhibits a fine, granular texture, with bands of alternating color, and is shown as the type of a bedded, stratified, or aqueous rock; the other is of crystalline texture, without arrangement in layers, and represents the group of massive, crystalline, or igneous rocks; and without further explanation than this, the students are asked to search out the area occupied by each rock, the line of contact and the phenomena exhibited along it, and to determine the relations of the two and the sequence of events in their history. Emphasis is given to the importance of personal work, and I take pains to say how much more valuable is the ability to determine the facts than the facts themselves. For several years it was my practice to point out the quarry-structure on the first excursion, thinking it too difficult for beginners to discover; but it seems now that that was almost a waste of time. It must be borne in mind that the students who are set to this work have already had in their preliminary course some account of just such facts as they now encounter in the field; they do not come to the task unprepared. Moreover, the attention of the class is not so well held by explanation from an instructor as by exploration for themselves. I therefore throw them at once on their difficulties; my own endeavor being rather to suggest observations and give encouragement than to answer questions. The questions are to be answered by the rocks. Even the best students are almost helpless at first,—so little has their general education taught them of independent, original observation even of a simple kind. One of the commonest statements is, "I don't know how to go to work," upon which it is necessary to repeat that the first step is simply to search out the area of the two rocks and the phenomena of their line of con-

tact. Not knowing how to go to work on such a problem does not mean ignorance of geology alone, but inexperience in the first requisite of scientific study. But the most characteristic feature of the first day's work is the frequency with which the instructor's authority is appealed to in decision of questions that lie open before the class. It is as if the weight of previous education were thrown on the side of dulling individual observation and judgment. It requires much care to avoid answering easy questions and thus defeating the objects of the excursion; and it requires more care to escape answering the questions without either discouraging or exasperating the questioners. A preliminary explanation is advisable, so that all may understand that there is nothing like a rebuff intended in the rather brusque counter-questions that serve best to direct the work where it should go. A student will sometimes come up to me, after a very insufficient search for facts on the ground, and, presenting a piece of the dike, say, with the idea that he is doing his full duty, "Isn't this melaphyr?" Now, as a matter of fact, he is, in this particular case, quite right; at least, so I am assured by competent lithologists, and later on he should be told so, but not at first. He has perhaps heard the name, melaphyr, associated with dark-colored, fine-grained rocks, and makes a lucky venture in using it; but as the object of the work is to train his observation, not mine, I throw the burden of proof upon him by asking in return, "Why do you think so?" "It looks like it." "What is melaphyr?" This may sound, as I now read it, very much like snubbing a praiseworthy inquiry; but see the result. Nine times out of ten the student says, "Oh, melaphyr? Melaphyr is—— I don't remember;" and this clears away the false knowledge that places names uppermost, and brings us down to a solid foundation for good work. No words must be used that cannot be defined: no suggestions must be made that cannot be justified by actual observation. The question may now be returned, "If you cannot say that this is melaphyr, what can you say about it?" "Well, it is a dike." "Why do you think so?" "It looks like one." "What is a dike?" "A dike is a mass of igneous rock filling a fracture in the country-rock." "Does this igneous rock fill such a fracture?" Again it appears how much easier it is to make assertions than to defend them; it is very seldom that a student will on his first endeavor suggest and ap-

ply the tests that furnish him with answers to such questions as these. He must make a second and a third attack before he really gets possession of all the facts about the dike,—its width, dip, and direction; the detail of its contact phenomena; its texture and its joints; but by persevering attention all these facts can be discovered from his own seeing, and then a good lesson is learned. A few such lessons correct the habit of using words recklessly, of making guesses and of offering unjustifiable suggestions in explanation of discovered facts. All this is very elementary; but it is the only basis for good work of a higher order. The better students take to the work with fine spirit; in some cases the opening of their eyes, the awakening of the consciousness that the work is in their hands and that they are really able to undertake it, is an inspiring experience to the instructor,—one that serves to carry him over the disappointment occasioned by the obdurate youths who insist that they, who have most to learn, cannot learn anything from the quarry before them. It is indeed a real pleasure to go with an appreciative new-comer to an old, familiar field and watch his rapid learning of new facts and methods: it is this that saves teaching from becoming monotonous, and makes it instead a very live work.

It is not always easy to secure a good conception of the truth and actuality of phenomena that are named and talked about familiarly enough; for example, the intrusion of the dike that has just been discovered. Some little commonplace detail is then an aid. I suggest that a certain part of the edge of the dike in question be examined minutely and drawn to scale, and that an explanation be sought for the forms thus discovered. A hinged fragment (Fig. 1) is soon found, but its full significance is seldom seen at first. It is part of a "stringer" between two joints which the intruding dike first opened (Fig. 2), the other part having been broken off and carried away out of sight in the further widening of the fracture. The penetration of the dense dike-matter into the narrowest

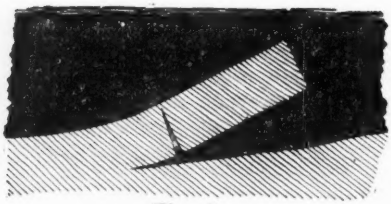


Fig 1.

parts of the crevices thus opened shows how mobile it was under the heat and pressure that caused its motion. This specific detail carries the observer back to the time of the intrusion, and gives reality to it.

A cross-section of the quarry is then asked for, and this brings up a very common difficulty arising from lack of practical geometrical knowledge. The same difficulty appears in determining the dip of the dike; it is as if the rocks were to be studied only in the two dimensions of length and breadth, without the third dimension of thickness or depth. Even so simple a geometrical matter as strike has generally to be labored over. The cross-section of the dike and slate is drawn to estimated scale with some care (Fig. 3) so as to make a beginning at least of correct under-ground interpretation, on which so much advanced work depends; and this leads to many new questions: Did the dike tilt the slate? Did the dike cause the variation in the dip of the slate? Did the dike appear before or after the slate was tilted?

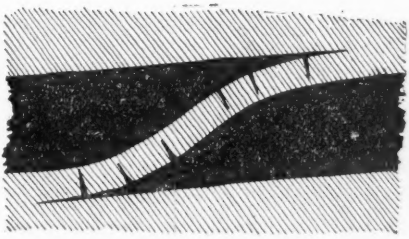


Fig 2.

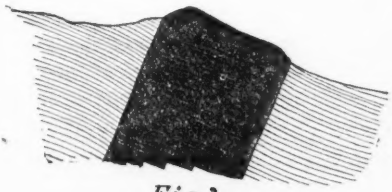


Fig 3

Such questions as these appear utterly obscure and unanswerable to many students: not because they have had no practice in geological investigation, but because they are unpractised in investigation itself. The relation of observation, hypothesis, and verification has not been unfolded to their minds, and it is for this reason that I lay so much stress both here and in the field on the importance of reasoning, as well as of observation, in geological work. Nothing is more important than for the student to perceive that he may discover and follow the legitimate sequence

of argument on which geological assertion is based. Practice in solving the questions proposed above leads to this desirable end. If the dike tilted the slate, the beds should dip away from the dike on both sides, as in Fig. 4. They do not, and it is therefore concluded that the slate was tilted by some force independent of the dikes. This is soon confirmed by finding that the dip of the slate is maintained at a tolerably even angle for a mile

Fig. 4

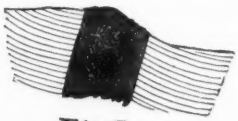


Fig. 5

or more, although intersected in various directions by many dikes. If the dike caused the local irregularity in the dip of the slate, the dip should be increased on the south and decreased on the north, as in Fig. 5; but the observed section in Fig. 3 shows a local increase of dip on both sides of the dike, as if the mass had been slightly sheared independently of the intrusion. Other dikes soon confirm the conclusion that their intrusion did not perceptibly affect the dip of the adjoining beds. In deciding the relation between the dates of intrusion and tilting, we must first rule out any argument based on the present tilted attitude of the dike; it may have been vertical originally and then tilted bodily with the slate to its present dip, or it may have been intruded at its present inclination; therefore no conclusion can be drawn from its dip. The only means here available for reaching an answer depend on a postulate concerning the joints in the slate. The joints *may* have been made in the slate before it was tilted, but they were almost surely made while the tilting was going on. Now, the dike is seen to have smooth joint-faces for the greater part of its walls; it must therefore have taken advantage of pre-existent joints in opening a way for its upward escape, otherwise its edge would be ragged. The dike therefore certainly came after the joints were made, and probably after the tilting was begun. The want of complete decision in this case is not considered reason for omitting its consideration. So much of geological reasoning leads only to probabilities that the student may as well make early acquaintance with this kind of half-way

demonstration, but great care must be taken to see that he fully recognizes the postulates of the argument and does not overdraw on their certainty. The desire for final settlement of all questions is strong in the student mind; questions that must be held open for further investigation are not always favorites, but I believe they are aids to the habit of mental deliberation.

In this particular case the doubt is soon lessened, for a little later, on the same excursion, a ragged dike is found breaking its way unevenly through the slate. The slate is jointed now, and traversed by smooth-walled dikes, showing that the irregularity of the ragged dike is due not to the impossibility of smooth breaks being made in the country-rock, but to their absence at the time of its intrusion. Finally, a smooth dike is found intersecting a ragged dike, giving new and safe evidence of the relatively early and late dates of their respective intrusions; and this is emphasized as a good illustration of a double approach to a single conclusion.

One of the most important exercises in connection with the field-work is the careful formulation, oral and written, of the conclusions reached and the means of reaching them. It helps to do away with the idea that a geologist is a collector of specimens rather than a collector of facts and arguments; it is good mental practice, and aids the student in any kind of work he may afterwards undertake; it is to most of the class the greatest profit that they carry from their excursions.

One of the most instructive quarries in Somerville is roughly drawn in Fig. 6. The attempt is here made to show the visible and covered rock areas, but it should be remembered that the visible rock is much less distinct in the dusty quarry than in the diagram. The tilted slates, S, S, are intersected by a forty-foot dike, AB, and both are cut by a double dike, CD, of moderate thickness. The large dike is soon seen to be horizontally faulted, and the question is put, When and where was it dislocated? the first answer generally refers the time and place to the newer dike, but careful search shows this to be wrong: the great slab of country-rock, which here separates the younger dike into two parts, is found to match the wall from which it was broken; it consists of slate opposite the slate wall, and of old-dike rock opposite the old dike. The newer dike therefore opened its way without any lateral shift of its walls. This is confirmed by

noticing a bend in the dike in the southern part of the quarry, the result of a crook in the fracture through which it rose: if there had been shearing motion on the fracture, the width of the

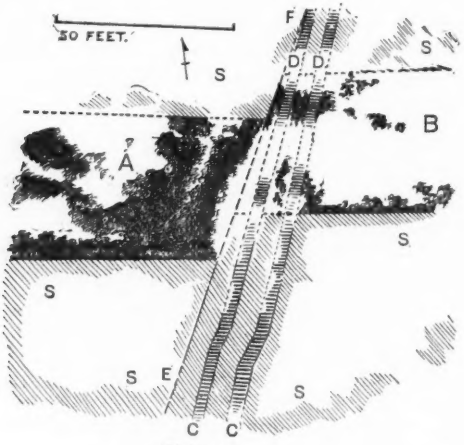


Fig 6

dike at the crook would have been increased or decreased, as in Fig. 7, *b*, *c*. The faulting of the large dike is thus shown to be independent of and to the west of the fractures occupied by the smaller one. Attention is now turned to a slickensided joint-

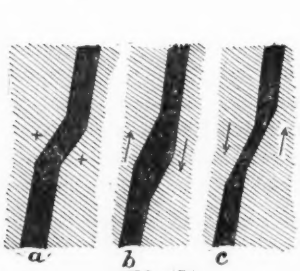


Fig 7

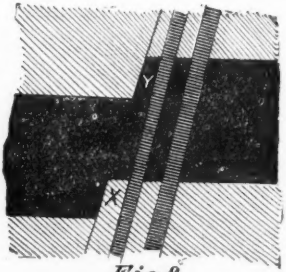


Fig 8

face, EF, Fig. 6, on which breccia and fault-scratches are common: perhaps the faulting occurred here; if so, how can it be demonstrated? Before looking again at the quarry every student

is asked to consider two simple alternatives; the large dike either was or was not moved on this fault-plane: what would be the consequence in either case? what test may be invented to settle the question? If the dike were not moved on this fault-plane (that is, if the dike were younger than the fault), its margins would be in line with each other on both sides of the fault; if the dike were moved on the fault-plane, its north and south margins would be offset, and both by the same amount. The shaded areas marked X, Y, Fig. 8, are thus seen to be of critical importance. If X consist of dike-rock and Y of slate, then the first alternative is true; if X be of slate and Y of dike-rock, then the second alternative is true. Especial attention is called to this deductive method of planning out lines of work. It is not sufficient simply to go out-doors and look about; the geologist must look first, then think, infer, plan, and at last lead his observations to the precise spot where they will do the most good; not the most good to the theory that may from some accident have secured his preference, but the most good in deciding critically among all the possibilities of the case. I think the history of geology need not be read far before one finds unfortunate examples of the neglect of this method. A fact is noted and a suggestion offered: the suggestion fits, and therefore it is accepted. But the student must be made to see that such a method will not lead to safe conclusions. It is quite possible that several processes may bring about the (apparently) same result. In such case it is manifestly unsafe to conclude that any one process did bring about the result merely because it could. Independent evidence must be found to check and confirm a suggested process after its suggestion before any confidence should be placed in it; further, all other apparently possible processes must be ruled out before any one can be accepted as the true and actual one. It is not easy to teach this to a class, and many will slip through the work without much appreciation of it.

Sequence of events, as constituting a portion of geological history, is a matter of importance. The case just described concludes with an illustration of it. The large dike was faulted after the intrusion of the smaller one, for on tracing the fault-plane to the northern side of the quarry, it is found to intersect the western member of the double dike, and brecciate it as well as the other rocks.

The numerous intersecting and faulted dikes on our sea-coast north of Boston present unexcelled examples for work of this kind: the amygdaloid in Brighton and its banded amygdules offer an instructive problem: but the phenomena of the drift are, as a rule, too complicated for local elementary treatment by the methods described above. Their observation needs to be supplemented by many facts drawn from larger fields than our excursions cover, and, although very interesting and valuable for class-work, they cannot be considered as useful in early teaching. Eight excursions of from four to six hours each, four in the fall and four in the spring, are thus occupied, and constitute the field-work that makes one-third part of our second course in geology. They are arranged so as to include as varied examples of structure and as varied problems as possible, but their aim is discovery and demonstration rather than exposition and illustration. They are intended to practise the power of observation, to awaken and develop the methods of geological reasoning, rather than merely to load the memory or inform the mind. Indeed, all this work is like exercise in a gymnasium. A young man who practises leaping over a vaulting-horse does not do so because he expects to meet the same vaulting-horse in after-life, but because he wishes to be able to leap over various obstacles outside of the gymnasium.

The winter season, when out-door work is stopped, can be well employed in securing some familiarity with our geological literature. Government and State reports with Prime's index thereto, the *American Journal of Science*, and the Royal Society's catalogue of scientific papers, with the more important journals that it leads to, are our chief materials, but of this I will not speak further.

At the end of the second course with its field-work, the student must consider carefully if he wish to go farther into geology. If he decide to go on, there are courses in lithology, economic geology, and palæontology before him, but these do not come strictly under the title of my essay. There is also a course in more advanced field-work, which is more to the present point. We find it difficult to give this course as it should be given, on account of its necessary conflict with other college duties. It is impossible to do much serious work without a whole day in the field, and this generally involves the unsatisfactory necessity of

"cutting" something else. The summer vacation may be utilized, but the student is not often well enough prepared to walk alone amidst the complication of problems that he meets. The summer school is a valued factor here, but this is a rather heavy tax on the instructor. We make the best of it in one way or another, and have succeeded in accomplishing some fairly good work; but in contemplating our moderate successes, and comparing them with the more finished products of the biological, chemical, and physical laboratories, we have occasion to lament the unwieldy character of geological problems. The biologist may cultivate his specimens in a jar, slice them nicely in his microtome, and examine them with his microscope, all comfortably arranged at a convenient table in a good light. Winter and summer, good weather and bad, his work of actual and original observation may go on. The geologist has no such good fortune. He must go out of town to his work, spending valuable time on the way there and back. In our present almost mapless condition he has to play topographer to the distraction of his attention, and his problems seldom, if ever, can have the conciseness or the singleness that may characterize work on animals and plants, and which is so desirable for the sake of the student. It is difficult to assign subjects or fields that allow of tolerably complete consideration by a student in the fall and spring half-years. The course in field-work cannot therefore be described with the definiteness given to the more elementary teaching. I can do little more than recount its objects.

The prime object of this advanced work is to teach the student not only to see for himself, but to see for himself when he is alone. In the first field course, where the instructor always accompanies the class, he may direct or suggest a profitable line of work, and hedge the party in from useless searching. It is very different when the student goes out most of the time alone, the instructor accompanying him only on preliminary and occasional later trips. It may be counted a good year's work if the student learn in that time to make an accurate, tolerably complete, and original report, written and graphic, on two areas assigned to him. The want of good topographic base-maps is a serious obstacle here; for the present we have to get along as well as may be with small-scale road-maps, on which the relief of the ground has practically no representation. The topo-

graphic survey of Massachusetts will, however, soon in part remedy this difficulty. The first questions that arise in the field concern the division of the country into its kinds; that is, simple areal geology. As all of our region is largely drift-covered, it is necessary for good work to map the rocks only where they are seen in outcrops, and to classify the drift as well as the rocks beneath it. The number of formations and sub-formations has to be discussed; the characteristics of all to be determined; and the boundaries to be marked out. This is so large a problem, and is often so complicated, that for the first two or three excursions the student may feel discouraged. The best scholars learn much by working out their own difficulties, with no more aid than is given by answers to admissible questions; those with less ability and perseverance need more immediate assistance. Repeated visits to the more significant localities are advised; for the beginner can hardly hope to reach at once the ambition of the most experienced geologist, and see in a first and single view not only the raw facts as they then appear, but also the critical points that are visible only after reflection. There are indeed few fields that do not repay second and third gleanings; if they seem barren after the first harvest, the gleaner had best ascribe the barrenness to his own want of skill.

There are two matters that I find need repeated mention in this work. First, the student must as far as possible finish his work as he goes, and not depend on later visits for doing what he can see on the first; a general reconnoissance is, of course, allowable, but unrecorded or sketchy work must not continue long. Each day's work must show a portion of the map finished as far as the knowledge then possessed will allow; however carefully this is done, there will be enough work for review suggested by later discoveries, and quite out of sight at first. The second matter is the need of distinguishing explicitly between what is seen and what is inferred. Printed maps generally omit this distinction on account of the large scale that it requires, but its omission on field-maps is inexcusable. Strong colors or full lines may be used to indicate well-ascertained facts; faint or dotted colors, and broken or dotted lines, aided by interrogation-points, will signify doubt. Uncolored portions of a final map should mean only unvisited country. A piece of country carefully surveyed and mapped in this way gives good exer-

cise, I believe, to the conscience as well as to the observing faculty.

Innumerable problems arise during this work: they are only too plentiful. The quality of the student may be finely gauged by the kind of questions they excite in him; it is needless to add that the quality of the instructor may be gauged by his answers! As a general rule, the answers should be like guide-boards pointing out the way to the settlement; not like coaches, carrying the passive questioner there: the working geologist must learn to go afoot, and to find his road rather than be led along it. I may be allowed in closing a single illustration from an actual case.

The problem in hand was concerning the former higher level of the sea about Boston. The opinion is commonly entertained that there was a post-glacial depression of the land amounting to about ninety feet; this being quoted from an old record of sea-shells found at that altitude near Winthrop, and confirmed by comparable records to the north and south. If such a depression occurred, the shore of the sea must have run around the margin of the present Boston basin. With this beginning, the student is sent into the field, to search the slopes up to one hundred feet for water-marks, and to search his mind for argument on the whole question. He must be on the alert to perceive any faint indication of a rock-cliff, sand-bar, or delta; he must keep his mind wide open to all available hypotheses for their explanation, even the most "cranky" being dismissed only for cause, not because it is unfashionably dressed; he must be strictly logical and impartial in applying tests to verify his hypotheses, and he must give up all that are found wanting. To the first view, the tramping over the country may seem the greater part of the field-work, but, to one who is able to take the full profit from it, the mental exercise is always much greater than the physical. Some students find the physical work the harder of the two.

The discussion will run about as follows: Admitting that the Winthrop shells are a true sea-deposit, there ought to be signs of an old sea-shore somewhere above the present level, unless the shore did not stand at any level long enough to make a recognizable mark, or unless the Boston basin was mostly occupied by glacial ice during the depression. Supposing that a shore-mark was made, what would be its appearance? The topography of the present shore-line has to be consulted, and

there one finds cliffs and benches, bars, marshes, and deltas. The first notable characteristic of these varied forms is that they stand almost at a single level, the bars being higher than the benches; the second is that they are arranged in close accordance with the general form of the surrounding country: a sea-cliff appears on an exposed headland, not at the end of a crooked, narrow inlet; a bar is strung along from a cliff-bench, and adjacent bars are sympathetic in their attitude; deltas are found only opposite valleys, and of a size proportionate to the stream that made them and to its supply with detritus. The distinctness of these forms is proportionate to the time during which the sea abided at their level; and from this we conclude at once that there has been no other post-glacial shore-line of anything like as long a life as the present one, along which cliffs and bars are so well made. Moreover, all these forms are of equivalent size on any given shore-line: if one cliff is formed others will be found in corresponding positions, and correlated bars and deltas will complete the record. Glacial imitations of shore-line topography are also discussed. With these generalizations thought out and talked over, the field-work begins to take shape: the student does not wander aimlessly over the area assigned to him, but searches intelligently for significant signs of water action. On finding a flat, sandy field extending seaward from the foot of a clean rocky slope, the hint is followed by contouring around the hill-sides; if the walk lead to a more sheltered position, look for little deltas where brooks come down ravines; if to a more exposed promontory, look for cut cliffs and built bars, and so on over the country. The results in this particular search were not what is commonly called "satisfactory"; that is, continuous and consistent shore-marks were not surely found up to a hundred feet elevation, although strongly suspected at sixty feet in some places; but this only means that the question is of a larger instead of a smaller order, not that it is unprofitable to the student. If the generally accepted post-glacial depression and higher stand of the sea at Boston is thus discredited by local observation, it must not be accepted on the ground of reported depression at not distant localities, for they may be similarly discredited, as has lately happened on Long Island. The occurrence of high-level shells at Winthrop does not alone suffice to prove so large a matter as

a change of continental level; it only opens a question that must be closed by independent evidence, and at present the evidence of *post*-glacial depression in Southern New England is very incomplete. The investigation is therefore highly satisfactory in leaving us with the watchfulness of uncertainty instead of blindfolding our eyes with a definite conclusion.

I have said but a word about summer schools. They deserve more mention, for they are invaluable; they cannot be replaced by any term-time instruction. The student is led by them to new fields and new problems, so widely different from those of his college course, that only the all-embracing subject of geology could bring them under one name. Continuity of work is also a great merit of these schools. They do not suffer from the distraction of other occupations that ordinary teaching has to contend with, and six steady weeks in summer may be made a full equivalent of an all-winter's interrupted course.

It need hardly be said that this course of instruction is not planned with a view of teaching the student much of what has been learned in geology. That is attended to in other courses by means of lectures, reading, and thesis-writing. The work here described is designed chiefly to place the student where he may gain something of the spirit of investigation. Rocks and structures are shown in but moderate variety, and quotation of simple fact thus learned is not expected to be of great service afterwards; but the facts that have been learned come as directly as possible from Nature, whom the student thus finds that even he may profitably question. Individual judgment is spurred on to take the place of the appeal to authority, and the judgment thus grows by exercise even to its own surprise. Thus, with observation and argument combined, the student finds himself possessed of general methods of work that prepare him to attack problems unlike any that he has met in his schooling. Further study under new teachers in new fields may then be followed to great advantage, but perhaps the best teacher at this stage is practical experience.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 712.)

CHINESE CABBAGE. *Brassica chinensis.*

BUT little appears to be recorded concerning the varieties of this cabbage, of which the *Pak choi* and the *Pe-tsai* only have reached European culture. It has, however, been long under cultivation in China, as it can be identified in Chinese works on agriculture of the fifth, sixteenth, seventeenth, and eighteenth centuries.[2] Loureiro[3] (1790) says also cultivated in Cochin China; and varieties are named with white and yellow flowers. The *Pak choi* has more resemblance to a chard than to a cabbage, having oblong or oval, dark, shining-green leaves upon long, very white, and swollen stalks. The *Pe-tsai*, however, rather resembles a Cos lettuce, forming an elongated head, rather full and compact, and the leaves a little wrinkled and undulate on the borders.[4] Both varieties have, however, a common aspect, and are annuals.

Considering that the round-headed cabbage is the only sort figured by the herbalists, and that the pointed-headed early cabbages appeared only at a comparatively recent date, and certain resemblances between the *Pe-tsai* and the long-headed cabbages, it is not an impossible suggestion that these cabbage-forms appeared as the effect of cross-fertilization with the Chinese cabbage; but until the Cabbage family has received more study in its varieties, and the results of hybridization are better understood, no certain conclusion can be reached. It is, however, certain that occasional rare sports or variables from the seed of our early long-headed cabbages show the heavy veining and the limb of the leaf extending down the stalk, and suggest strongly the Chinese type. At present, however, our views as to the origin of our various types of cabbage must be considered as largely speculative.

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Bretschneider, Bot. Sin., 59, 78, 83, 85.

[3] Loureiro, Fl. Cochinch., 397.

[4] Vilmorin, The Veg. Gard., 1885, 147.

Chives. *Allium schœnoprasum* L.

These are small and unimportant members of the Onion family, found native throughout Europe, in Siberia even to Kamschatka,[1] and in North America, upon the shores of Lakes Huron, Superior, and northward;[2] but the form found in the Alps comes the nearest to that under cultivation. Although probably known to the ancients, yet we seem unable to fully identify them with the varieties of the onion named by Theophrastus, Columella, and others. They were planted in gardens in Europe in the sixteenth century, and were in American gardens preceding 1806. In England, described by Gerarde[3] (1597), called "a pleasant Sawce and good Pot-herb" by Worlidge[4] in 1683, are among seedsmen's supplies[5] in 1726, and are recorded as formerly in great request, but now of little regard, by Bryant[6] in 1783.

Chives, sives,[4] civet or sweth,[3] are called, in France, *ciboulette, civette, appetit, cive, fausse echalote;* in Germany, *schnittlauch, grasslauch;* Flanders and Holland, *bieslook;* in Italy, *cipollina;* in Spain, *cebollino;*[7] in Portugal, *cebolinha;* in Denmark, *graslog;* in Poland, *luczer-lupny.*[8]

The only indication of variety I find is in Noisette,[9] who enumerates the *civette*, the *cive d'Angleterre*, and the *cive de Portugal*, but says these are the same, only modified by soil. The use of the leaves as a condiment is well known. The plant is an humble one, and is propagated by the bulbs, for, although it produces flowers, these are invariably sterile, according to Vilmorin.

Chufa. *Cyperus esculentus* L.

The chufa was distributed from the United States Patent Office in 1854, and has received a spasmodic culture in gardens. It is much cultivated in Southern Europe, Asia, and Africa, becoming of importance at Valence, in Galicia, and in the environs of Rosetta and Damietta, in Egypt.[10] In Hungary it is grown for the seeds, used as a coffee substitute,[11] but in general for its tubers, which are sweet, nutty, and palatable. These bulbs, says Bryant,[12]

[1] De Candolle, Orig. des Pl. Cult., 57.
[2] Gray, Man. of Bot.
[3] Gerarde, Herbal, 1597, 139.
[4] Worlidge, Syst. Hort., 1683, 194.
[5] Townsend, Seedsman, 1726, 25.
[6] Bryant, Fl. Diet., 1783, 92.
[7] Vilmorin, Les Pl. Pot., 1883, 156.
[8] McIntosh, Book of the Gard., ii. 47.
[9] Noisette, Man., 1829, 353.
[10] Heuze, Les Pl. Alim., ii. 551.
[11] Loudon, Enc. of Ag., 98.
[12] Bryant, Fl. Diet., 1783, 29.

are greatly esteemed in Italy and some parts of Germany, and are frequently brought to table by way of dessert. At Constantinople the tubers appear in the markets, and are eaten raw, or made into a conserve.[1] Gerarde, in 1633, speaks of their extensive use in Italy, being hawked about the streets, and, at Verona, eaten as dainties.[2] They now appear in the English markets under the name of Zulu nuts.[3] It must also have been esteemed in ancient times, for tubers have been found in Egyptian tombs of the twelfth dynasty, or from two thousand two hundred to two thousand four hundred years before Christ.[4]

Laurembergius, in his "Apparatus Plantarum," 1632, calls them *Gramen amygdalosum*, commonly called *Thrasi veronensium;* conveniently called *Dulcichinum, Dulcinium, Cyperus esculentus, Cyperus angustifolius, Juncus avellana, Margarita ægyptia*, etc. They are figured or described by nearly all the early botanists.

The *chufa, earth-almond*, or *rush-nut* is called, in France, *souchet comestible, amande de terre, souchet sultan, souchet tubereux, trasi;* in Germany, *erdmandel;* in Flanders, *aardmandel;* in Italy, *mandorla di terra, dolcicchini;* in Spain, *chufa, cotufa;*[5] in the Soudan, *nebbon;* in Egypt, *ab-el-azis;*[6] in Arabic, *hab-el-a*, —i.e., *granum dilectum.*[7]

Notwithstanding the long-continued culture of this plant, I find no varieties described.

Clary. *Salvia sclarea* L.

The common Clary was formerly much more cultivated in gardens than at present. Townsend,[8] in 1726, says "the Leaves of it are used in Omlets, made with Eggs, and so must be in a garden." In 1778, Mawe[9] gives three varieties,—the broad-leaved, the long-leaved, and the most wrinkled-leaved. It is mentioned as cultivated in England by Ray,[10] 1686; Gerarde,[11] 1597; and it is the orminum of Turner,[12] 1538. It was in American gardens preceding 1806,[13] and now occurs wild in Pennsylvania, naturalized as an escape,[14] its home being the East Med-

[1] Walsh., Hort. Trans., vi. 50.
[2] Gerarde, Herbal, 1633, 32.
[3] Gard. Chron., June 24, 1882, 838.
[4] Schweinfurth, Nature, Jan. 31, 1883, 314.
[5] Vilmorin, Les Pl. Pot., 1883, 551.
[6] Heuze, Les Pl. Alim., ii. 551.
[7] Delile, Fl. Ægypt, illust.
[8] Townsend, Seedsman, 1726, 34.
[9] Mawe, Gard., 1778.
[10] Ray, Hist., 1686, 543.
[11] Gerarde, Herb., 1597, 626.
[12] Turner, Libellus (fac-simile reprint), 1877.
[13] McMahon, Am. Gard. Kal., 1806.
[14] Gray, Syn. Fl., ii. pt. 1, 372.

iterranean countries. The leaves are used for seasoning, but their use with us has been largely superseded by sage, and, although the seed is yet sold by some of the seedsmen, I imagine that it is but little grown.

The Clary is called, in France, *sauge sclarée, sclarée, toute-bonne, orvale;* in Germany, *muscateller salbei.*

Claytonia. *Claytonia perfoliata* Don.

The leaves of this plant are eaten as salad, or cooked like ordinary spinage. It is a native of Cuba, as also of North America, where the variety *exigua* Torrey is in popular use in California as a potherb.[1] It was first described in 1794, but in 1829 was not named by Noisette[2] for French gardens, and in 1855 is said by De Candolle[3] to be occasionally cultivated as a vegetable in England. It is now included by Vilmorin among French vegetables.

In England it is called *winter purslane;* in France, *claytone perfoliée, claytone de Cuba, pourpier d'hiver;* in Flanders, *doorwas;* in Holland, *winter-postelijn;* in Spain, *verdolaga de Cuba.*

Its synonymy is:

Claytonia perfoliata Don. Pursh, Fl. of N. Am., i. 170.
C. perfoliata Don., *var. exigua* Torr. Brewer & Watson, Bot. of Cal.
C. Cubensis, Humb. et Bonpl. Kunth, Syn., iii. 379.

Corchorus. *Corchorus olitorius* L.

This plant is valued as a spinage plant in warm countries. It is mentioned by Pliny[4] among Egyptian potherbs, and Alpinus,[5] in 1592, says that no herb is more commonly used among the Egyptian foods. Forskal[6] also mentions its cultivation in Egypt, and notes it among the cultivated esculents of Arabia. In India it occurs wild, and the leaves are gathered and eaten as spinage.[7] In tropical Africa it is both spontaneous and cultivated as a vegetable,[8] and it is cultivated in the vegetable-gardens of the Mauritius.[9] In Jamaica the plant is frequently met with in gardens, but has, in a great measure, ceased to be cultivated,

[1] Brewer & Watson, Bot. of Cal.
[2] Noisette, Man., 1829.
[3] De Candolle, Geog. Bot., 662.
[4] Pliny, lib. xxi. c. 52, c. 106.
[5] Alpinus, De Plant. Ægypt, 1592, 39.
[6] Forskal, Fl. Ægypt.-Arab., xciii. 101.
[7] Speede, Ind. Handb. of Gard.
[8] Oliver, Fl. of Trop. Afr., i. 262.
[9] Bojer, Fl. Maurit., 42.

although the leaves are used as a spinage.[1] It is now cultivated in French gardens for its young leaves, which are eaten in salads.[2] It is recorded by Burr[3] as in American gardens in 1863, but I have never seen the plant growing. This plant furnishes a portion of the Jute fibre of commerce.

The *Jew's mallow*, or *Corchorus*, is called, in France, *corette potagere, guimauve potagere, mauve des juifs, brede malabare;* in Germany, *gemuse-Corchorus, nusskraut;*[2] in Arabia, *melochia;*[4] in Arabic, *meloukhyeh;*[5] in Bengali, *pat, koshta, bhungee,*[6] *bhunjee pat;*[7] in Hindustani, *singin janaseha;*[7] in Sanscrit, *putta;*[6] in Telegu, *parinta.*[8]

I find no varieties recorded.

Coriander. *Coriandrum sativum* L.

The ripe fruits of the coriander have served as a spice and a seasoning from very remote times, its seeds having been found in Egyptian tombs of the twenty-first dynasty,[9] and a thousand or so years later Pliny[10] says the best came to Italy from Egypt. Cato,[11] in the third century before Christ, recommends coriander as a seasoning; and Columella,[12] in the first century of our era, and Palladius,[13] in the third, direct its planting. The plant was well known in Britain prior to the Norman conquest,[14] and was carried to Massachusetts before 1670.[15] In China it can be identified in an agricultural treatise of the fifth century, and is classed as cultivated by later writers of the sixteenth and eighteenth centuries.[16] In Cochin China it is recorded as less grown than in China.[17] In India it is largely used by the natives as a condiment,[18] is grown at the Mauritius,[19] and has even reached Paraguay, and is in especial esteem for condimental purposes in some parts of Peru.[20]

Coriander, called coryander and colander by Turner[21] in 1538,

[1] Macfadyen, Jam., i. 108.
[2] Vilmorin, Les Pl. Pot., 168.
[3] Burr, Field and Gard. Veg., 338.
[4] Forskal, Fl. Ægypt.-Arab., xciii. 101.
[5] Delile, Fl. Ægypt, illust.
[6] Birdwood, Veg. Prod. of Bomb., 338.
[7] Drury, Useful Pl. of Ind., 159.
[8] C. Benson, Saidapet Farm, Madras.
[9] Nature, May 31, 1883, 113.
[10] Pliny, lib. xx. c. 82.
[11] Cato, c. 157.
[12] Columella, lib. vi. c. 33; lib. x. c. 244; lib. xi. c. 3.
[13] Palladius, lib. iii. c. 24; lib. iv. c. 9, etc.
[14] Pharmacographia, 1879, 329.
[15] Josselyn, Rar.
[16] Bretschneider, Bot. Sin., 78, 59, 85.
[17] Loureiro, Cochinch., 180.
[18] Dutt, Hindu Mat. Med., 175.
[19] Bojer, Hort. Maur.
[20] Johnson, Useful Pl., 125.
[21] Turner, Libellus, 1538.

is called, in France, *coriandre;* in Germany, *coriander;* in Flanders and Holland, *koriander;* in Denmark, *koriander;* in Italy, *coriandorlo;* in Spain, *culantro, cilantro.*[1] The name is probably derived from the Greek *koris*, a bug, from the offensive smell of the leaves. In Arabic, *kouzbarah*,[2] *kuzeerah;*[3] in Bengali, *dhunya;*[4] in Ceylon, *cotumbaroo;* in Malay, *mety;* in Persian, *kushneez;* in Tamil and Telegu, *cottamillie;*[3] in Sanscrit, *dunya, dhanyaca.*[3]

Notwithstanding this extended period of cultivation, I find no indication of varieties under cultivation.

Corn. *Zea mays* L., var. *saccharata.*

The history of sweet corn, so far as we have discovered it, is given in the American Naturalist for July, 1885. It is first noticed in 1779. In the "Report of the New York Agricultural Experiment Station" for 1884 I have described thirty-three sorts, and in the report for 1886 a new form collected from the Indians of Mexico is mentioned and partly described. This vegetable is grown far more in the United States than in Europe, and has become an object of field-culture for the supply of the canning industries.

The European names of sweet corn I do not find noted, except the *mais sucre* of the French. By Vilmorin the generic name of the species is applied to this variety in his synonymy.

The presence of three distinct types, varying not alone in appearance, but as well in their climatic adaptations, and the large number of varieties quite distinct in minor features, indicate a previous culture far more extended than appears in my recorded notes. It certainly does not seem reasonable to believe that sweet corn was confined until 1779 to North American aboriginal culture alone, and yet I have not even a clue that suggests otherwise.

Corn Salad. *Valerianella olitoria* Moench.

This annual plant has been found spontaneous in all temperate Europe as far as 60° north; in Southern Europe to the Canary Isles, Madeira, and the Azores; in North Africa, Asia Minor,

[1] Vilmorin, Les Pl. Pot., 168.
[2] Delile, Fl. Ægypt, illust.
[3] Birdwood, Veg. Prod. of Bomb., 39, 162, 237.
[4] Drury, Useful Pl. of Ind., 162.

and in the region of the Caucasus.[1] It seems quite a variable plant in nature, but as long ago as 1623 Bauhin[2] records its variability in size, and occurring with narrow, broad, and entire leaves. It is described by Lobel[3] in 1576, and by Dalechamp[4] in 1587, as also by Camerarius[5] in 1588, but as occurring in fields, and without mention of culture, although its value as a salad is recognized. In 1597, Gerarde[6] says it has grown in use among the French and Dutch strangers in England, and "hath beene sowen in gardens as a sallad herbe." He figures two varieties. J. Bauhin[7] describes two sorts, and gives Tabernæmontanus as a witness that it was found in gardens as well as in fields and vineyards. Ray,[8] in 1686, quotes J. Bauhin only, and Chabræus,[9] in 1677, describes it as grown in gardens as a salad herb. Worlidge[10] in 1683, Meager[11] in 1683, Quintyne[12] in 1693 and 1704, Townsend[13] in 1726, Stevenson[14] in 1765, Mawe[15] in 1778, Bryant[16] in 1783,—all refer to its culture in England. In France, according to Heuze,[17] it is spoken of as cultivated by Olivier de Serres, and is referred to as if a well-known cultivated salad in "Le Jardinier Solitaire," 1612. It was in American gardens previous to 1806.[18]

Vilmorin[19] describes four varieties, which are tolerably distinct. All these have blunt leaves. The variety quite frequently distributed for American gardens is that which is figured by the herbalists as having pointed leaves, as, for instance,—

Phu minimum alterum. Lob., 1576, 412; Lugd., 1587, 1127;
Polypremnum. Lugd., 1587, 554;
Lactuca agnina. Ger., 1597, 242; etc.

The round-leaved form, such as the *mache ronde* of Vilmorin, has its type figured by Dodonæus in his "Pemptades," 1616, under the name of *album olus.*

[1] De Candolle, Orig. Des Pl. Cult., 37.
[2] Bauhin, Pin., 1623, 165, No. xix.
[3] Lobel, Obs., 1576, 413; fig., p. 412.
[4] Hist. Gen. Lugd., 1587, 554, 1127; fig.
[5] Camerarius, Hort., 1588, 175.
[6] Gerarde, Herbal, 1597, 243.
[7] J. Bauhin, Hist., 1651, iii. 324.
[8] Ray, Hist., 1686, 392.
[9] Chabræus, 1677, 437.
[10] Worlidge, Syst.-Hort., 1683, 214.
[11] Meager, Eng. Gard., 1683 (?), 61.
[12] Quintyne, Comm. Gard., 1693, 144; 1704, 205.
[13] Townsend, Seedsman, 1726, 16.
[14] Stevenson, 1765, 34.
[15] Mawe, Gard., 1778.
[16] Bryant, Fl. Diet., 1783, 116.
[17] Heuze, Les Pl. Alim., i. v.
[18] McMahon, Am. Gard. Kal., 1806.
[19] Vilmorin, The Veg. Gard., 1885, 202.

The names of the *Corn salad*, or *Fetticus*, or *Lamb's lettuce*, are, in France, *mache commune, accroupie, barbe de chanoine, blanchette, blanquette, boursette, chuquette, clairette, coquille, doucette, gallinette, laitue de brebis, orillette, pommette, poule grasse, rampon* (à Geneve), *salade de ble, salade de chanoine, salade royale;* in Germany, *ackersalat, feldsalat, lammersalat, mausohr, rabinschen, rapunzel, schafmaulchen;* in Flanders and Holland, *koornsalad, veldsalad;* in Holland, *veldsla;* in Denmark, *kropsalat;* in Italy, *valeriana, erba riccia, dolcetta, gallinelle,*[1] *sarzet;*[2] in Spain, *canonigos;* in Portugal, *herva benta;* in the Mauritius, *mache, doucette.*[3]

Among the more ancient names are: Belgian, *velt cropper*, Lob., 1576; *witmoes, veltecrop, elcerooge*, Dod., 1616; gallo-belgian, *sallade de chanoine*, Lob., 1756; in English, *lamb's lettuce, corne sallade*, Gerarde, 1597; in France, *blanchette, poule grasse*, Lugd., 1587; *mache*, "Le Jard. Solit.," 1612.

(To be continued.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE meeting of the American Association for the Advancement of Science, which has just closed its sessions in New York, was in some respects a noteworthy one. Nature was kinder to her worshippers than has been often the case at this season of the year in regions of small elevation and corresponding latitude, and the temperature experienced in New York was a delightful interlude in a season of exceptional heat and humidity. Although many of the citizens were living at their summer resorts, the entertainment furnished was fully equal to the anticipations and needs of the Association. Indeed, greater hospitality could not have been enjoyed without impairing the effectiveness of the meetings, and it is fortunate from this stand-point that New York's capacity in this respect was not more seriously taxed. As to the meeting, it may be truly said that the quality of the papers offered never was higher, and their interest and importance was never greater. The attendance, though not equal to

[1] Vilmorin, Les Pl. Pot., 1883, 322.
[2] Allioni, Fl. Pied., 1785, n. 12.
[3] Bojer, Hort. Maurit., 1837, 174.

that at the Boston and Philadelphia meetings, was very good, numbering about seven hundred and fifty members. The United States Geological Survey was better represented than at any previous meeting. The excursions about the city covered a wider range of interest than at any previous meeting; physicists, social economists, biologists, and geologists being equally well provided for. In all respects the local committee, aided by the New York Academy of Sciences, succeeded in making the meeting enjoyable to all participants.

Most of the members will agree with us, however, that some comments on the treatment of the Association by the press of New York are in order. It may be asserted that at no late meeting has the work of the Association met with less appreciation from the newspapers of the locality where it has met than in New York. Some of the reports published were of the flippant, jocular type, the wit in some instances apparently emanating from very callow reportorial brains. In no instance were full reports given, but the fullest were always those of the least scientific communications, such as that of a Chinese gentleman, which never should have been read at all. We had thought that the reports of the *Tribune* would have redeemed the reputation of the press so far as possible, but even these depreciated after a very good beginning, and terminated in an extraordinary *fiasco* in a farewell editorial on August the 18th. Had we a funny column, we would reprint the first half of this editorial entire, but we must be content with making some comments on it, for it represents very correctly the attitude of the New York press towards American science for many years past.

The editorial opens with the following cheerful assertion: "The most noteworthy scientific congress that has met on this side of the Atlantic was the Montreal session of the British Association in 1884." We commend this sentence as a model of veracity (?) and good taste (?). "At the close of the session one of the learned presidents of the sections declared that its most important contribution to the world's stock of knowledge was the announcement, in a cable despatch from Australia, that monotremes were shown by actual observation to be oviparous." . . . "Indeed, the meetings of the British and American Associations are seldom memorable for discoveries or even discussions of phenomenal importance. A few notable addresses have been

made in England by such leaders of the scientific world as Professor Huxley and Professor Tyndall, . . . " Now, we are not prepared to speak for the British Association, but it has been quite the custom for American scientists to announce their most important discoveries in papers read before the American Association. Such was the case at the Philadelphia meeting, which followed immediately the notable meeting at Montreal. Among other important communications made, it was announced that the ancestors of the monotremes had been discovered in the reptiles of the Permian formation of Texas, a fact which was new, and important from every point of view. The fact that the monotremes are oviparous had been known for perhaps forty years. Another fact discovered by the English biologist, that the segmentation of the yelk of the monotremes is meroblastic, was really new, and formed a remarkable confirmation of the discovery announced in Philadelphia. Such coincident discoveries are rare in the history of science, and the present instance was, under the circumstances, especially interesting. As usual, the *Tribune* cannot cite any "notable addresses" delivered before the Association by Americans. Under the circumstances, our past presidents and vice-presidents will pardon us the assertion that such have been really delivered in this country also! To what extent the general indifference to science which prevails in New York is due to this kind of writing it might be interesting to inquire. The succeeding paragraph of this editorial shows some appreciation of the New York session, for which we extend thanks. We must, nevertheless, proffer to the *Tribune* one piece of advice,—viz., that it employ on its scientific work in future an American, and one who knows something of American science and scientists. In this way it may become what it once aimed to be in New York City, a scientific missionary *in partibus infidelium.*

THE American Committee of the International Congress of Geologists has survived the perils which threatened it at the New York meeting of the American Association. After an existence of several years, and the accomplishment of a great deal of work, it began to attract the attention of the present director of the United States Geological Survey. Although a member of the committee, the director has not taken part in its work

until just before the meeting of the Association, excepting by deputy, who was permitted by courtesy to be present at its deliberations. At the present stage of progress the director became very desirous of controlling the committee, and exhausted all the arts of parliamentary usage to accomplish that result. His efforts were, however, not successful, and the committee received a new lease of life by a resolution of approval adopted by Section E (the Geological), and of continuation by the Association at large. The committee thus represents officially in the Congress, American geological opinion, and it will no doubt endeavor to do so with the utmost impartiality. As a representative body it is well constituted. It embraces the following representation:

	Members.
United States Geological Survey	4
United States Geological Survey of the Territories (Hayden's)	1
United States Geological Survey W. of 100th mer. (Wheeler's)	1
State Survey, Alabama	1
State Survey, Minnesota	1
State Survey, New York	1
State Survey, New Hampshire	1
State Survey, Pennsylvania	2
State Survey, New Jersey	1
	13

In our opinion no scientific or other reasonable ground for a change in the representative character of the committee exists, and we are glad that no change has been made.

WITH the death of Professor Spencer F. Baird a landmark in American science has disappeared. We find it difficult to express adequately our sense of the important bearing which the life of Professor Baird has had on the present state of science in America. More than any other man he built up and sustained the existing body of zoologists in this country by his generous recognition and still more generous material support. To him, more than to any one man, science owes the recognition it has had in the councils of the nation, and the substantial support which it has received at the hands of our government. No one ever justly questioned his motives, for it was known to everybody that they were not selfish, and that the advancement of science was the one object of his life. His success is attested by the National Museum, and the Fish Commission, of the United States; two achievements

which have few parallels in the history of science. In the presence of Professor Baird's immense services to science in America, we can nevertheless pause to pay a tribute to the worth of his character. Perhaps his leading trait was a comprehensive benevolence which knew no distinctions, but embraced all in its benefactions to the limit of possibility.

Professor Baird's disinterested love of science will not be lost to us by his death. To his foresight is due the fact that he will probably be succeeded by men equally catholic with himself, and equally able to maintain the dignity of science at the national capital. We refer to Professor S. P. Langley, the present assistant secretary, and Mr. G. Brown Goode, assistant director of the National Museum.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Morphology and Origin of the Ichthyopterygia.[1]—There is no group of reptiles, the Testudinata perhaps excluded, of which the morphology of the skeleton and the origin has been more discussed than that of the Ichthyopterygia.

As the name says, the Ichthyosaurs were long considered as animals which had retained characters of fishes. The limb-bones developed as paddles were regarded as original stages, forming a link between the fishes and the higher Vertebrata. I shall show in the following note that the Ichthyosaurs are specialized Sphenodon-like reptiles, and that their fins are not original but secondary formations, like the paddles of the Cetaceans.

The Skull.—The skull is only comparable with that of the Rhynchocephalia, especially Sphenodon and the Lacertilia. The only real difference is that, like in the Cetaceans, the anterior part of the skull has been very much elongated. The *general* structure of the skull resembles that of the dolphins. In its *morphology* it is a copy of the Sphenodon skull.

The foramen magnum is bounded by four bones,—the large basioccipital, the two exoccipitals, and the supraoccipital. These parts are well known. Of the otic bones two are separated; the third, the epiotic, if ever free, is coossified as in all reptiles with the supraoccipitals. The opisthotic is a pretty large conical bone, touching the exoccipital and supraoccipital.

[1] A paper read before the American Association for the Advancement of Science, August 12, 1887.

The prootic is a small flat elliptical bone, connected with the base of the skull, the supraoccipital, and the opisthotic. The structure of the bones shows that there must have been developed large masses of cartilage, still more than in young seaturtles, connecting these bones.

Between the basioccipital and the quadrate a strong handle-like bone is expanded, fitting in a grove of the quadrate. This is the stapes, as Professor Cope correctly suggested, exactly in the same position as in Sphenodon, in which it is of similar shape but not so stout.

Turning now to the upper part of the skull, we find the parietal bones of exactly the same structure as in Sphenodon, and in front of those the very small frontals.

The parietal foramen, which is very large, as in Sphenodon, is situated between the frontals and parietals or in the frontals, in a similar way as in Sphenodon. In the upper part of the Sphenodon skull the parietal foramen is formed entirely by the parietals; in the lower part by both the parietals and frontals. The nasals in Ichthyosaurus are very large bones, touching the frontals, parietals, postfrontals, prefrontals, lachrymals, and premaxillaries.

We have now to consider that part of the skull situated between the supratemporal fossa, the orbits, and the quadrate.

The supratemporal fossa is formed by three bones,—the parietal, the postfrontal, and a big bone forming its posterior and exterior border. This bone, which is connected also with the quadrate and another bone which joins the quadrate, quadratojugal, postorbital, and postfrontal, is the *supratemporal* of the Lacertilia, which is united in Sphenodon to the squamosal.

This bone is called mastoid by Owen, squamosal by Seeley and Cope, but it is in fact the supratemporal bone of the Lacertilia.

Between this bone, the postfrontal, postorbital, quadratojugal, and quadrate, another bone is articulated. This bone represents the *true* squamosal of the Lacertilia, the *prosquamosal* of Owen, and the *supraquadrate* of Seeley.

The place which is taken in Ichthyosaurus by the supratemporal and squamosal is taken in Sphenodon by one bone only. This represents the supratemporosquamosal.

The quadratojugal of Ichthyosaurus is connected with the squamosal, postorbital, jugal, and quadrate exactly as in Sphenodon, where it ossifies later with the quadrate.

There is a foramen in Ichthyosaurus, between the quadrate and quadratojugal just as in Sphenodon. Ichthyosaurus has an epipterygoid (columella), as A. Smith Woodward has shown, of the same form and connection as Sphenodon.

The lachrymal is free from the prefrontal in Ichthyosaurus, as in many Lacertilians; it is united with that bone in Sphenodon.

The vertebræ of Ichthyosaurus are only specialized from a Sphenodon-like form in which the notochordal character was

already lost. The ribs are two-headed, and are always connected with the centrum of the vertebræ. There are only three small intercentra developed between the basioccipital and atlas, and the two next vertebræ.

The abdominal ribs consist of a median piece just as in Sphenodon, to this one or two lateral pieces are attached on both sides. In Sphenodon there are two pairs of abdominal ribs connected with one pair of true ribs, in Ichthyosaurus only one.

The shoulder-girdle is only comparable with that of Sphenodon; the clavicles and interclavicles are very much alike; the scapula and coracoid resemble very much the same elements in young Sphenodons when they are still free.

The pelvis of Ichthyosaurus is in a rudimentary condition; it contains the three elements, but a comparison with other pelves is of no value.

The limbs are specialized for the animal's life in water from some land-living form, as I shall show.

The limbs or paddles of the Ichthyopterygia were a principal reason for giving a peculiar position to those animals in the system.

I have shown before, on logical reasons, that the paddles of Ichthyosaurus were not original but adapted. To-day I can give the proofs for this.

In the Museo Civico of Milano, in Italy, are some specimens of Ichthyosaurus from the Trias of Besano. They have been noted lately by Professor F. Basani, and called *Ichthyosaurus cornalianus.* The specimens measure from 50 to 90 cm. only.

The teeth are of smaller number than in the other Ichthyosaurians, and of two forms. But the most important character not mentioned by Basani is the structure of the limbs. Radius and ulna are not as in the other Ichthyopterygia, short bones which touch each other without space, but they are more elongate, leaving a space between them. This one character alone is sufficient to establish a new genus, which I propose to call *Mixosaurus;* constituting a distinct family, the *Mixosauridæ.*

The fins of Baptanodon or Sauranodon Marsh have been regarded as the oldest ones. It is just the reverse of it; they are the newest, most specialized forms.

The bone considered by Professor Marsh as intermedium is not this element, but the ulna; the ulna of Professor Marsh represents probably the pisiforme.

The oldest Ichthyopterygia had few phalanges and not more than five digits; radius and ulna were longer than broad, and separated by a space. Later, through the adaptation to the water, more phalanges were developed, more digits appeared, mostly by division of the former or by new formation on the ulnar side. I have never found a new digit developed on the radial side.

The fin of Baptanodon was developed by the trans-location of the pisiforme or another element of a new-formed ray to the humerus.

Just the same we observe in the Sauropterygia.

In the oldest Triassic forms, the Lariosauridæ, we have forms with extremities, where radius and ulna are long bones, and the number of phalanges as in the Lacertilians. In the Liassic specimens, the Plesiosauridæ, radius and ulna become smaller, the number of phalanges enlarged.

In the specimens of the Kimmeridge, *Pliosaurus*, (? in all) we have three short bones connected with the humerus, just as in Baptanodon.

The Cetacean paddle has developed in the same way as Ryder has suggested; a new proof is given by the Sirenidæ.

Flower says, in the last edition of his "Osteology of the Mammalia," that the number of phalanges in the Sirenia is never increased in number beyond the limit usual in the Mammalia,—*that is, three.* But Dr. H. Gadow, in Cambridge, England, showed me a manus of *Manatus americ.*, prepared in alcohol, which contained a fourth small ossified phalange in the third digit, and one of *Halicore dugong* which contained an ossified fourth phalange at the fourth, and a cartilaginous fourth in the third digit.

This shows how the supernumerary phalanges were developed, and it is remarkable to say that the embryo of *Halicore* examined by Leboucq contained only three phalanges. The increase takes place during the life of the individual through mechanical influence.

I do not longer doubt that the Ichthyopterygia were developed from land-living reptiles which very much approached the Sphenodontidæ.

Classification of the Ichthyopterygia.—a. Radius and ulna elongated, separated by a space in the middle. Teeth of two forms, but not so numerous as in the Ichthyosauridæ. Small animals. Triassic.

Family *Mixosauridæ* Baur.

Genus *Mixosaurus* Baur.

b. Radius and ulna short bones, touching each other. Teeth well developed and numerous.

Family *Ichthyosauridæ* Bonaparte.

Genus *Ichthyosaurus* Koenig. There are, however, several genera contained in Ichthyosaurus, as Seeley has already suggested.

c. Radius, ulna, and a third bone articulating with the humerus; teeth rudimentary or absent.[1]

Family *Baptanodontidæ* Marsh.

Genus *Baptanodon* Marsh.—*Dr. G. Baur, New Haven, Conn.*

[1] I have seen small teeth at the end of the jaws of the Baptanodontidæ contained in the private collection of Mr. Leeds in Peterborough, England.

The Address of Vice-President G. K. Gilbert before Section E; A. A. A. S., Columbia College, New York, August 10, 1887.—Mr. Gilbert's address was a well-written composition, which bore the same title as the pamphlet published by the undersigned, under the auspices of the American Committee,—"The Work of the International Congress of Geologists." The easy and flowing style of the address was to have been expected by those who had read any of Mr. Gilbert's previous productions; but it must not be supposed that his fecundity of expression led him into saying too much. He has not been betrayed, for instance, into any general mention of the past work of the American Committee delegates to the Congress; nor even into any particular mention of that part of it which furnished the greater part of the material on which his address was based.

In speaking of the need for a word "to denote indefinitely an aggregate of strata," since to the word *formation*, formerly used in this manner, the Congress has attached a specific meaning, he says,—

> "I suggest that we may advantageously enrich our language by the permanent adoption of *terrane*, a word whose English meaning has not been well established."

This is a singular, though doubtless inadvertent, plagiarism, since the two international committees (see "Report of Am. Com.," p. 43, etc., *a*, *c*, *d*, and pp. 50, 9, etc.) have employed the word in just this way. In the debates of the Congress also (*ibid.*, p. 22) "Professor Renevier proposed the term *terrane* (*terrain*) to avoid prejudging the rank in the classification of these rocks" (Archean). "He objected to the use of the term in any systematic sense, but believed it might be employed in a general sense." This, of course, inferred the use of the French word, with whatever pronunciation and spelling, in other tongues.

His suggestion as to the use of the termination "al" to convey ideas of time, as in Archeal, Cretaceal, Laramal, Belly Riveral, Bitter Creekal, if it will induce the local-taxonomy geologists of Mr. Gilbert's school to admit, through its employment, any generality in geological classification, will probably be easily introduced. Still, after having conceded to him an unusual command of his mother-tongue and great skill in its use, one cannot help regarding his innovations as usually more *logal* (as perhaps he himself would have phrased it of another) than logical. Nevertheless, let us hasten to observe that they are always euphonious; and, in fact, in reading his well-rounded periods, one may imagine them the agreeable cadence of word-drops caught up by some sprite of the river of language, and with the added glory of hue and tone from the intellectual light which floods them, falling back into their native bed.

In the serious matter of the address there are some passages to approve and some to disapprove. For example, in speaking

of the Congress's suggestions as to the terminations to be added to indicate groups, systems, series, etc., Mr. Gilbert says,—

"It would be impossible for a geologist to name or allude to a terrane without declaring its rank," etc.

To this it may be said that schemes of classification are not made for systematizing what we do not know, but what we do know. Nevertheless, it would not be an insuperable obstacle to speak of the "blankary, blankic, or blankian terrane." Equally ill-founded is the fear that by too systematic a classification—

". . . Taxonomy would be conceived by many geologists as an end instead of a means, . . . and energy would be wasted in taxonomic refinement and taxonomic controversy."

Energy is wasted now, and a great deal more than if there were some fixed principle to guide the controversialists.

One line of objection, curious in one who must be assumed to have accustomed himself to take broad views of things, is this:

"A committee appointed for the purpose formulated rules for the establishment of the names of genera and species, and their report was adopted by the Congress. I have no opinion to express as to the wisdom of the rules, but it is a matter of surprise that a body of geologists assumed to speak with authority on the subjects. From one point of view palæontology is a part of geology; from another point of view it is a part of biology. In so far as it names genera and species it is purely biologic, and it would seem proper that students of fossils unite with students of living animals and living plants in the adoption of rules of nomenclature."

Is it forgotten by Mr. Gilbert that the field of palæontology has been occupied almost exclusively by students of living plants and animals on account of its rich promise of results in determining those questions of derivative origin with which the address of this year's president of the Association was concerned? These geologic-biologists specially equipped to prosecute new inquiries are the very members of the Congress who have attempted the classification to which he alludes. He adds:

"The same is true of mineralogy, in regard to which no action has been taken. The most intimate relations of systematic mineralogy are with chemistry."

The last sentence would hardly secure Mr. Gilbert's critical approval were he aware that, from the earliest dawn of the science of mineralogy up to the present time, some of the most pre-eminent among mineralogists have denied this. But, even if it were so, some of those best able as chemists to grapple with petrological problems have entered the field of geology for the purpose of devoting themselves to it. Towards the close of the address he touches again upon this point, as follows:

"When a matter is proposed for regulation by the Congress, the first question which should be asked is whether it falls within the legitimate purview of a convention of geologists."

But what does not fall within such purview which bears, however indirectly, upon the riddles they are trying to unravel? Is the science of geology to be classed with those occupations

which relate solely and exclusively to one thing? (Perhaps Mr. Gilbert would call them *monotaxic*.) Or is it not rather a campaign requiring for its prosecution the infantry, artillery, cavalry, pontoon-trains, sappers and miners, engineers, and all the various departments of the largest army of science? If civil engineers with a little experience in camp become among the best military engineers, if our frontiersmen make the best scouts, why may not biologists, chemists, and crystallographers whose ambition urges them to seek a wider field than their laboratories become the very leaders which geology demands? In point of fact, they do; and if Mr. Gilbert will observe in the debates of the Congress, or of any other body which discusses these questions, who take the principal parts, and whose influence is most felt, he will find men eminent in the domains of special knowledge before they ventured to advise in that realm where it was applied to the attainment of a particular purpose.

It would seem, from certain parts of the address, that Mr. Gilbert half fears and half denies that the Congress possesses infallibility, but thinks that it should never pronounce in favor of a classification until all knowledge relating to the subject has been exhausted. He says, in regard to the acceptance by the Congress of a classification of the eruptive rocks,—

"With the rapid growth of knowledge and ideas, classifications are continually remodelled, and the best is in danger of becoming obsolete before it has been printed and circulated."

This evinces a curious view of the purpose of science. Is the same not equally true of philology, of ethnology, and of anything else which can be made the subject of investigation and transformed into organized knowledge? Does Mr. Gilbert expect that the heavens will fall if the classifications of the Congress need remodelling when time and further study have given more light? Are we to wait for omniscience before we attempt to classify? Or will not, rather, the changes which the future is certain to require, however great, be easier and less distracting when the whole enlightened world can take them at once by mutual agreement?

But perhaps Mr. Gilbert does not consider the co-ordination of knowledge in geology essential; one would judge so, at least, by his remark that

"—every system and every group is local. . . . If I have properly characterized stratigraphic systems, if they are both natural and local, it goes without saying that the classification of the strata of all countries in a dozen or so systems . . . is impossible."

Were that qualifying "if" not there one would be tempted to remark that, though the writer thinks it goes *without* saying, very few will concede that this statement goes *with* the saying, and in the absence of any proof. It is a thing which Mr. Gilbert cannot possibly know enough to deny, although he may think

that none of the supporters of the proposition know enough to assert it.

In parts of the address there is some appearance of unfairness in stating the position of the Congress. Take this, for instance:

"There can be no doubt that those who originally organized the work contemplated the *enactment* of a stratigraphic classification to be applied to the entire earth, and the selection of a color scheme for use either in all geologic maps or in all general geologic maps. But at the Berlin session the committee in charge of the work on the map of Europe pressed the Congress for the determination of questions on which hung the completion of the map, *and many hasty decisions were reached, while not a few disputed points were referred to the Map Committee.* The debates indicate that much *or* all of this work was provisional or of merely local application, but the *resolutions* adopted show little qualification. It should be added that the official minutes of the meeting are still unpublished."

—[It might, with grace, also have been here added whence his knowledge of the unofficial minutes came.]—The use of "enactment" in this sense conveys an impression the reverse of the fact. The Congress assembled to consult, to compare notes, and recommend; not to enact. Of course, it was, and is, hoped and believed that some plan will be arrived at of universal application. Without this, geology would be simply a more intellectual pastime than collecting postage-stamps or measuring property lines; but the implication of the entire succeeding sentence is, that the Congress, being pressed, "enacted" certain things, and left other things to be "enacted" by a subordinate committee. That all the points decided had reference to an experiment which was to be made the subject of future criticism is rendered unclear by the "much *or* all," and by the little qualification which it is said the resolutions have.

Yet this should have been understood by Mr. Gilbert, for he says, farther on,—

"By a series of resolutions a partial scheme has been selected, one color at a time, and the completion of the plan has been left to the Committee on the Map of Europe."

This certainly implies that the Map Committee has consulted the Congress as to certain portions of the former's task, and not that the latter has "enacted" colors for the world. Further:

"It is understood, in a general way, that the Congress reserves final action, and that the published legend not only belongs specifically to the map of Europe, but is provisional; still, as the map, *if generally approved*, will unquestionably be declared by the Congress an authoritative pattern for the guidance of map-makers, the plan should be freely criticised at its present stage."

If the map is open to much criticism it cannot be generally approved, and if not, it is quite proper that it should be declared a pattern. The Congress has quite abundantly shown its aversion to dictating or enacting contrary to the judgment of qualified objectors. Mr. Gilbert

. . . "cannot too strongly nor too earnestly insist that a System which is universal is artificial."

Of course, all human systems are artificial; but if Mr. Gilbert means inapplicable, and if any considerable number of competent geologists agree with him, it must be admitted that the very idea of an international congress is an absurdity. It may be doubted, however, whether this be the case, when one considers the many eminent men who have interested themselves in the Congress. Passing over his statement that no strata in the Eastern United States are pronounced Jurassic with confidence (as one in which he differs from at least as good an authority as himself), he objects to separating "a continuous rock system" (conformable strata?) which contains fossils resembling forms of the lower Jurassic at the top, and lower down others resembling forms of the Triassic, into those two systems, and says, "A Jurassic system thus established would be necessarily artificial." But in Great Britain the beds from the bottom of the Primordial to the base of the Upper Silurian make a single conformable sequence; and many other examples in Europe and this country might be cited. Indeed, it is strongly insisted by the Director of the United States Geological Survey that "systems or divisions of the second order (above the Archean) should be based primarily on biology and secondarily on physical structure." Mr. Gilbert's definition of a System as

"a great terrane separated from terranes above and below *by great unconformities*, or great life-breaks, or both,"

differs from that of his chief, as well as from the common usage.

But Mr. Gilbert prefers his

"own definition of a system, making it natural, and consequently local;"

and he opposes

"any attempt to coerce the geology of one country in a rigid matrix formed over and shaped by the geology of another country."

As to the latter, so do all geologists; but it is a different proposition to make a matrix by combining the "geologies" of all countries and fitting as much as there happens to be of each into the general mould, leaving the others to complete the gaps.

He objects to the provisional color scheme of the Map Committee, that

"—it is adjusted to the rock systems of Europe exclusively, and makes no provision whatever for the systems of other parts of the earth. The geologists of Wisconsin, for example, cannot use it without calling the Keweenawan either Cambrian or Archean," . . . if they believe that "it belongs to neither of these two categories."

The above, to be intelligible, needs a note explaining that certain eminent geologists have lately come to the conclusion that the term Archean should be restricted to the lower part of what up to the present time the world has understood it to define, and that another term should be applied to the rocks between its upper portion, as thus defined, and the base of the Primordial.

This criticism, then, assumes the form of a serious sort of pun, or a puzzle based upon the ambiguity of a word. As the greater number of the world's geologists have not yet accepted this new use of "Archean," the criticism is not fatal. Of course, if the new group be accepted, the Keweenawan will be interpolated between it and the Paleozoic.

It is not the purpose of this article to criticise the plan of the spectrum proposed by Mr. Gilbert. As he says, it has been very fully discussed in the proceedings of the Bologna Congress; but it may be said that one of his canons—viz., that the groups of "hues and tones," called by the vulgar simply colors, which are to serve as a scale—

"... must be so chosen that the degree of separateness of adjacent colors shall be everywhere the same, as judged by the *normal* human eye."

will be very difficult to carry into effect, in default of the discovery of, and agreement upon, that normal eye. To no two eyes of the ordinary kind would the "separateness" be likely to appear the same. It ought also to be mentioned that, in adding the hues of purple to one end or the other of the spectrum to increase the range of the time-scale colors, he violates his own rule, and renders it impracticable to assign by its wave-length a color to an intermediate rock-mass.

The portion of the address, however, most open to objection is the end of it. He says,—

"A classification is a generalized expression of the facts of observation outside the domain of the voter. If it comprises all the essential facts its sufficiency will be eventually recognized, whether its authority is individual or collective. If it does not comprise them it will inevitably be superseded, by whatever authority it may have been instituted."

This argument savors somewhat of Oriental fatalism, but no exception need be taken to the words beyond the fact that a vote of competent men is a good way to arrive at a conclusion whether a certain formulative statement be or be not the desired generalized expression. The conviction that such a vote carries will be strong in proportion to its unanimity, but, in any case, it will have to stand the test to which Mr. Gilbert alludes. He proceeds:

"For this reason I am opposed to the classification by the Congress of the sedimentary formations, and likewise to the classification of the volcanic rocks; and I also regard it as ill advised that the Congress undertook the preparation of a map of Europe, for that, if more than a work of compilation, is a work of classification."

Poor Congress! About to be bereft of the power to consider the objects for which it was created, why was it called into purposeless being? Suppose that when Lavoisier and his coadjutors assembled the famous congress to decide upon a system of nomenclature and to agree upon a theory of chemistry (then largely through his efforts emerging from chaos to order) some one had said, "Your congress should consider no questions of science,

but only questions of names. Within the field of names it should only comprehend what Stahl and the phlogistonists understand by them. It should therefore not attempt the classification of the elements, nor the classification of compounds made by combining elements. It should discuss no analysis unless the data be compiled from existing authorities. It should not regulate the nomenclature of somatology, for that belongs to physics and mechanics; it should not regulate the nomenclature of reactions, for that belongs to magic,—in fact, it should not meddle with names at all, for that is the domain of philology:"—would we ever have had a science of chemistry at all, or would Lavoisier and his colleagues have persisted in their reckless course of counselling and devising?

In this connection the words of the great Berzelius are very applicable:

"In every science a systematic nomenclature is necessary, but in none more than in chemistry. The confusion which reigned prior to the happy idea of Guyton de Morveau is a proof. The nomenclature which chemists have employed since 1780 is the fruit of his labors, sustained and directed by Lavoisier, Berthollet, and Fourcroy. The advantage that it presents is that whoever learns to recognize a compound can give it its true name without knowing it beforehand, so that it is unnecessary to charge the memory with a large number of different terms. . . . Furthermore, scientific nomenclature is in itself the expression of a complete theory, so that if, on the one hand, the theory furnish the name, on the other the name indicates the theory. It has been objected to this relation of a nomenclature to theory that it obliges the names to be changed with the theories, which would not be necessary in the employment of purely technical terms, that are always preserved without alteration. But as these changes are ordinarily the results of progress in the direction of clearer notions, the change of nomenclature, far from injuring, is, on the contrary, another means for facilitating the march of ideas. *In general, nothing which contributes towards rendering any part of a science stationary is advantageous:* everything must advance equally in proportion to the multiplication of discoveries and knowledge." (Berzelius, "Treatise on Chemistry," vol. i., Introduction, 1829.)

It is tolerably sure that if Mr. Gilbert expects the International Congress of Geologists to eschew all questions of science in its debates, and devote itself to the employment of playing at logograms exclusively with old data, he will be disappointed.—*Persifor Frazer.*

On the Homologies of Edestus.[1]—The genus Edestus was formed by Professor Leidy to comprise certain singular fossils from the coal-measures of the West, about which various theories have been held. The one generally received is that they are dorsal spines used as weapons of defence or offence. About a year and a half ago Dr. H. Woodward, of London, suggested that they might be pectoral fins similar to those of Pelecopterus, a genus described by Professor Cope from the Cretaceous of Kansas. The absence of any trace of articulation, the apparent evidence that there were ligaments extending to the base of

[1] Abstract of a paper read before the American Association for the Advancement of Science, August 15, 1887.

the denticles, the segmented character of the fossils, and the fact that the segments are found singly, and of different sizes, which would indicate that they are shed like teeth, together with the presence of a slender curved basal bone (similar to that in Onychodus of the Devonian of Ohio) in the Australian form described by Dr. Woodward, led the author to think that these fossils are neither dorsal spines nor pectoral fins, but intermandibular teeth, which had a membranous or cartilaginous support in the American forms, and an osseous support in the Australian. These supports would bear the same relation to the mandibular arch that the glosso-hyal does to the hyoid arch.—*Fanny R. M. Hitchcock.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In the continuation[2] of his work on the rocks collected by the "Challenger" expedition, Renard has reached the discussion of the geology of the islands in the Indian Ocean. Those situated in the meridional part of the ocean are divided into five groups, three of which have been examined in detail. They are all of volcanic origin, and are in no way connected with Madagascar or the land within the Antarctic circle. The island *Marion*[3] is formed of volcanic rocks of two distinct ages, readily distinguishable by differences in the character of the vegetation they support. They both consist of feldspathic basalts, with anorthite as the plagioclastic constituent. The rocks of the island *Heard* are very similar to those of *Marion*. In the neighborhood of Corinthian Bay the prevailing rock is a feldspathic basalt, in which Baveno twins of bytownite are crowded together in groups. Many of these are optically anomalous in their action between crossed nicols, a fact supposed by Renard to be due to their fine lamellation. The olivine shows cleavages parallel to oP and a pinacoid. In some cases it has suffered alteration into pilite. In addition to the basalts a few specimens of limburgite were also collected.——The same author has recently studied the rocks of Kerquellen Land,[4] which had already been examined to some extent by J. Roth.[5] Renard finds that these rocks consist principally of basalts, with amygdules of analcite and zeolites. The grains of olivine in them are grouped together like the chondra of meteoric stones. In addition to the basalts there occur on the island trachites, limburgite, and phonolites. Of these the trachytes and phonolites are older than the basalts.——Two late articles on the petrography of the Tyrol add several interesting facts to our knowledge of this re-

[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.
[2] American Naturalist, Notes, 1886, p. 640.
[3] Bull. d. l. Soc. Roy. de Belg., 1886, iii. p. 245.
[4] Bul. du Mus. Roy. d'Hist. Nat. de Belg., iv. p. 223.
[5] Monatsb. d. Kön. Akad. Berlin, 1875, p. 723.

gion. Baron von Foullon[1] separates the porphyrites of the Tyrol into quartz-porphyrites, quartz-mica-porphyrites, and diabase-porphyrites. In connection with the first group, Von Foullon records the replacement of hornblende by augite near the contact of the quartz-porphyrite and granite. The second group is characterized by the presence of garnet and an epidote, with the unusual pleochroism wine-yellow and violet. Intergrowths of this mineral and hornblende take place in such a manner that the axes b and c′ of the former are parallel with c′ and b of the latter. The hornblende in the rock often shows a parting parallel to oP. ——In the *Neues Jahrbuch* Cathrein[2] describes six rocks from various localities in the Alps. A staurolite-mica-schist occurs at Oberinnthal. It contains numerous hemimorphic crystals of tourmaline. A garnet amphibolite is remarkable for the occurrence in it of plagioclase pseudomorphs of garnet. The interior of the garnets are changed into plagioclase, around which is an exterior zone of compact hornblende. The serpentine of this region is an altered pyroxene rock. The remains of bronzite, enstatite, and diallage can still be detected in it. The most instructive portion of the paper is that devoted to the porphyrites and pitchstone-porphyries. Of the former several varieties are recognized. The first contains epidotized plagioclase and crystals of compact hornblende. In the second, in which uralite and a little augite occur instead of hornblende, the plagioclase is sausuritized. A third variety contains brown garnets in oscillatory combinations of the dodecahedron and the icositetrahedron. They are the oldest constituent. Of the pitchstone-porphyry the author says, this rock occurs in large independent masses, breaking through the prevailing quartz-porphyry in large dikes and bosses, no transition between the two being anywhere discernible.——A schistose rock from the Grossarlthal in the Alps contains chloritoid instead of mica as its bisilicate constituent. Cathrein[3] calls it a chloritoid schist. It contains nearly five per cent. of rutile and sphene.——The rocks of the Hereroland in Southwest Africa belong principally to the class of the older eruptives.[4] The quartz grains of some of the granites contain fluid inclusions with hexahedral crystals, and are pierced through by little needles of sillimanite. The most interesting observations are those on the crystalline schists. The gneiss is remarkable for the unusual association and decomposition of its constituents. The biotite is intergrown with sillimanite, and contains zircon crystals surrounded by pleochroic "*höfe*." Orthoclase and microcline are intergrown in the manner described by Becke.[5] The former has

[1] Jahrb. d. k. k. geol. Reichsaust, 1886, p. 747.
[2] Neues Jahrb. f. Min., etc., 1887, i. p. 147.
[3] Min. u. Petrog. Mitth., viii., 1887, p. 331.
[4] H. Wulf, Min. u. Petrog. Mitth., viii., 1887, p. 193.
[5] *Cf.* Min. u. Petrog. Mitth., iv., Taf. ii. Fig. 8.

undergone alteration into pseudophite, yielding a product having very much the appearance of serpentinized olivine. The augite gneisses are divided into scapolite-bearing varieties and those that contain wallastonite. The cleavage in the scapolite, as observed by Wulf, is parallel to ∞P, and is not parallel to ∞P∞, as given in the text-books. The latter is probably a parting. The composition of the augite in both varieties approaches that of diopside. Other rocks described by Wulf are diorites, basalts, amphibolites, diorite-schists, mica-schists, etc.——Lacroix describes a gabbro from St. Clement in the Puy-de-Dôme, which contains, in addition to the usual constituents, the minerals vesuvianite, sphene, and wallastonite. The feldspar is anorthite with only 0.53 per cent. of Na_2O. It presents the appearance of having been crushed and recemented, the cementing material possessing the same optical orientation as the pieces it surrounds.

Mineralogical News.—Within the past few months the properties of quite a number of rare minerals have been investigated by mineralogists in this country and in Europe, with the results indicated below. W. C. Brögger[1] describes in detail the characteristics of *låvenite* and *cappelinite*. The former occurs on the island Låven in Langesundsfjord, and is also found in the eleolite syenite[2] of the Province of Rio Janeiro, Brazil. It forms brown to yellow, slightly transparent crystals, with a prismatic habit and vitreous lustre. It is monoclinic in crystallization with $\dot{a} : \dot{b} : c' = 1.0811 : 1 : 0.8133$, $\beta = 71° 24\frac{1}{2}'$. The twinning and the cleavage planes are parallel to the orthopinacoid, while the plane of the optical axes is the clinopinacoid. The mineral is strongly pleochroic, $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$ = red-brown, yellowish-green, and wine-yellow. Its specific gravity is 3.51, and its composition:

SiO_2	ZrO_2	Fe_2O_3 (?)	MnO	CaO	Na_2O	Loss at red heat
33.71	31.65	5.64	5.06	11.00	11 32	1.03

Cappelinite is found in a small vein in the augite syenite of Little Arö in Langesundsfjord. It occurs in thick brown hexagonal prismatic crystals with a fatty lustre. Their axial ration is 1 : 0.4301. Their analysis yielded:

SiO_2	B_2O_3	Y_2O_3	$La(Di)_2O_3$	Ce_2O_3	ThO_2	BaO	CaO	Na_2O	K_2O	H_2O
14.16	17.13	52.55	2.97	1.23	0.79	8.15	0.61	0.39	0.21	1.81

Warwickite, the borotitanate of magnesium and iron, occurring at Edenville, N. Y., is generally found in prismatic crystals elongated in the direction of the vertical axis, with a cleavage parallel to the clinopinacoid. Lacroix[3] has succeeded in obtaining measurements of these, which indicate a symmetry corresponding to that of the rhombic system. In accordance with

[1] Zeitsch. f. Kryst., x., 1885, p. 503, and Geol. För. i. Stockh. Förh., Bd. vii. p. 598.

[2] Fr. Graeff, N. J. B., 1887, i. p. 201. [3] Bul. d. l. Soc. Fr. du Min., ix. p. 74.

this view the plane of their optical axes is the orthopinacoid. Their bisectrix is positive and perpendicular to $\infty P\bar{\infty}$. $2E = 125°$. The mineral is pleochroic in red and brown tints. *Withamite* from the porphyrites of Glencoe, County Argyle, Scotland, the same author regards[1] simply as epidote. He also thinks[2] that *mismondine*, *sasonite*, *ottrelite*, *venasquite*, and *phyllite* are merely varieties of chloritoid, the optical properties of which he describes at length. *Xantholite* he supposed[3] to be identical with staurolite.——J. Strüver[4] does not consider *gastaldite* as a variety of glaucophane, but regards both minerals as distinct members of the amphibole group.——According to Lacroix[5] the *kirwanite* (of Thomson) is a mixture of amphibole, secondary quartz, and epidote. The same author[6] finds that *hullite* from Belfast is not homogeneous, and therefore should not be regarded as a definite mineral species. He states also that Dufrenoy's *dréelite* is an impure barite.——New analyses of *agalmatolite*[7] indicate that most of the substance to which this name has been given really possesses no definite composition, but is probably a mixture of silica and hydrated silicates of potassium and aluminium, resulting from the decomposition of orthoclase.——An apparently regular mineral has been found by Vom Rath[8] in the druses of an andesite near the apex of Cerro S. Cristobal near Pachuca, Mexico. It occurs in small octahedra, sometimes twinned according to the spinel law. It is often intergrown with tridymite. Hardness = 6–7. Specific gravity = 2.27. Its composition is $SiO_2 = 91$ per cent. $Fe_2O_3.Al_2O_3 = 6.2$ per cent. Both Vom Rath and Bauer regard it as most probably regularly crystallizing silica. It has been called *christobalite* to distinguish it from quartz, tridymite, vestan (Jensch, *Pog. Ann.*, 1858, p. 320), and asmanite.——A new variety of dufrenite has been observed by Messrs. Kinch, Butler,[9] and Miers in Cornwall, England. When fresh it is found in small black or apple-green orthorhombic plates, which in the thin section appear yellow or brown. Its hardness is 4.5 and specific gravity 3.233. An analysis yielded:

H_2O	CuO	P_2O_5	Fe_2O_3	CaO
10.68	0.96	30.42	55.93	1.51

The composition of the mineral corresponds with that of Streng's *kraurite*.[10]——The composition of a micaceous mineral from a limestone in the Kaiserstuhl is recorded by Knop[11] as follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MgO	K_2O	H_2O
35.91	1.15	15.18	10.85	0.89	22.80	2.90	10.77

[1] Bul. d. l. Soc. Fr. du Min., ix. p. 75.
[2] Ib., p. 76.
[3] Ib., p. 78.
[4] Neues Jahrb. f. Min., etc., 1887, i. p. 217.
[5] Bul. d. l. Soc. Min. d. Fr., viii., 1885, p. 428.
[6] Ib., p. 435.
[7] Min. Mag., July, 1886, pp. 24 and 29; Dec. 1886, p. 74.
[8] Neues Jahrb. f. Min., etc., 1887, i. p. 198.
[9] Min. Mag., Dec. 1886, p. 65.
[10] Neues Jahrb. f. Min., 1881, i. p. 101.
[11] Zeits. f. Kryst., xii. p. 607.

This mineral differs from biotite in the possession of water and a smaller percentage of potassium. As Hoppe-Seyler[1] found that when biotite is subjected to the action of carbon dioxide and water it loses potassium and gains water, Knop thinks that this mineral, which he calls *pseudobiotite*, may have been formed in the same way, especially as it is found most abundantly near the contact of limestone with phonolite. Knop further discusses[2] the constitution of biotite, but reaches no conclusions further than that the atomic relations of its constituents are $SiO_2 : R_2O_3 : RO = 2 : 1 : 1.5$, corresponding to the formula $R_4''R_2'''Si_3O_{13}$.——Professor A. H. Chester[3] has recently communicated some notes on the chemical composition of a few obscure American minerals. *Fuchsite* from Aird Island, in Lake Huron, occurs in small layers and masses in a crystallized dolomite. According to Professor Chester's analysis it contains:

SiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
45.49	31.08	3.09	trace	0.51	3.36	9.76	0.90	5.85

A pink celestite from Landsville, Oneida County, N. Y., yielded results corresponding to a mixture of 84 per cent. $SrSo_4$, 11 per cent. $BaSo_4$, and 5 per cent. $CaSo_4$. The mineral has been called *baryto-celestite*, but Professor Chester considers it more probably an isomorphous mixture of the three carbonates. In addition to the analyses given above, there are in the paper quite a number of new analyses reported, the most interesting being those of *okenite*, *scorodite*, *brochantite*, and *zinkenite*.——Igelström[4] reports the existence of a manganiferous *vesuvianite* with 4.72 per cent. of MnO.

Crystallographic News.—Chas. O. Trechman[5] describes crystals of barite from Addiewell in Midlothian, England. They are found in small brilliant crystals covering rhombohedra of pearl spar and the dull faces of an older genera of barite. The new forms detected upon them are $7P\breve{\infty}$, $\frac{3}{8}P\breve{\infty}$, $P\frac{1}{3}$, $\frac{3}{4}P\frac{3}{2}$, $\frac{2}{3}P\frac{2}{1}$, and $\frac{1}{5}P\frac{11}{5}$, $\breve{a} : b : c' = .8152 : 1 : 1.3136$.——The examination by Hussak[6] of fluorite crystals from various localities, with reference to the question of optical anomalies, has revealed nothing definite in regard to the anomalous action in this case. He finds, however, that the structure of the mineral corresponds to the orthorhombic symmetry, with the axis of least elasticity normal to one of the cubic faces.——Mr. H. A. Miers[7] mentions orthoclase twins from the augite andesite of Kilimanjaro, in which the composition face (as well as the twinning plane) is the orthopinacoid. The crystals are bounded by the planes ∞P, $2P\breve{\infty}$, $\infty P\breve{\infty}$, and $0P$.

[1] Zeits. d. deuts. Geol. Ges., 1875, p. 515.
[2] Zeits. f. Kryst., xii. p. 588.
[3] Amer. Jour. Sci., April, 1887, p. 284.
[4] Bul. d. l. Soc. Fr. d. Min., ix. p. 22.
[5] Min. Mag., Dec. 1886, p. 49.
[6] Zeits. f. Kryst., xii. p. 552.
[7] Min. Mag., July, 1886, p. 10.

Miscellaneous.—Fremy[1] has succeeded in obtaining small well-colored crystals of ruby by subjecting to a red heat a mixture of alumina and minium, and also by heating to a high temperature equal weights of alumina and barium fluoride. In both cases the color was produced by the addition of small quantities of potassium bi-chromate.——Measurable crystals of quartz have been produced[2] by heating an enclosed dialysed solution of silica to a temperature of 320°. The crystals, ½ mm. in length, possessed the forms R, —R, ∝R, and in two cases $+\frac{2P2}{4}$. Tridymite was obtained by fusing pieces of very acid rocks with the powder of basalts and melaphyres.——A concretion of coarse tourmaline pegmatite in the tourmaline granite near Pisek, Bohemia, contains pseudomorphs[3] of pyrite after tourmaline.——The rare mineral langite has been found by Von Foullon[4] forming the cement of a breccia in Pockwerke, Garnstein.

ENTOMOLOGY.[5]

Observations on the Female Form of Phengodes laticollis Horn.—Entomologists will remember the interest taken, about one year ago, in the discovery that the female form of a Lampyrid[6] (*Zarhipis riversi*) was larva-like, and that the three stages—larva, pupa, and adult—differed but little. On the night of September 27, 1886, a larviform, luminous beetle was collected on one of the walks of the campus of the University of North Carolina.

FIG. 1.—*Phengodes laticollis*, showing luminosity.

Pupa State.—As the insect cast its skin only once—in the spring of 1887—after coming into my possession, this must represent its pupa state.

Description.—Length when crawling, two and three-fourths inches; width, three-eighths inch. Flattened, larviform, luminous; composed of twelve segments (exclusive of the head), tapering gently behind, and more decidedly on the three anterior segments. Chitinous plates on dorsum blackish-brown, the second to eleventh inclusive with a pair of large, light-brown, oval spots. Anal plate light brown, except a median band of blackish-brown, convex behind. First plate light brown, except a median irregular and two lateral blackish-brown spots. Below each stigmata, on the fourth to eleventh segments inclusive, are two longitudinal folds, the anterior half of each fold

[1] Comptes Rendus, civ., 1887, p. 737.
[2] Chrustchoff, Neues Jahrb. f. Min., etc., 1887, i. p. 205.
[3] E. Döll, Verh. k. k. geol. Reichs., 14, p. 350. [4] Ib., 1886, p. 464.
[5] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.
[6] Am. Nat., xx. 648. See also Ent. Am., iii. 203.

blackish-brown, shading into light brown in the middle, and becoming yellowish-white, with an olive tinge on the posterior half. Posterior edge of each dorsal plate dark olive-brown; the posterior angles of the pro-, meso-, and meta-thoracic plate and the anterior third of the pro-thoracic plate yellowish-white, tinged with olive. On the fifth to ninth segments inclusive (ventral surface) are one pair each of small, elongated, black dots, corresponding very nearly in position with the pairs of luminous organs of the ventral surface. Anal proleg blackish-brown above, yellowish-white below.

Besides the stigmata on the fourth to eleventh segments, there is one on the ventral surface of each anterior corner of the meso-thoracic segment; also two pairs of small dorsal spiracles, one each between the fourth and fifth, and fifth and sixth segments.

Thoracic legs brown, suffused with yellowish-olive. Tarsus two-jointed; single claw curved. Anterior edge of femur with a row of short hairs; under edge of tibia and first joint of tarsus with a similar row of hairs; under edge of last joint of tarsus with small, short papillæ. Head black, 2½ mm. in width, retractile. Mandibles curved, sickle-shaped, black. Antennæ four-jointed; labial palpi two-jointed (or three-jointed? Those of a larva collected in July appear three-jointed); maxillary palpi four-jointed.

The location and form of the phosphorescent lights are as follows: On each side is a row of circular ones, one on each segment from the second to the twelfth inclusive. Each of these is nearly one-eighth inch in diameter, and situated in the posterior end of the upper longitudinal fold. The posterior edge of each segment, from the second to the twelfth inclusive, emits a band of light. On the under surface are five pair, mere points, one pair each on the fifth to ninth segments.

The general appearance is that of a worm beautifully illuminated with bluish-white lights, which are disposed in a longitudinal row on each side, and in transverse bands. (See Fig. 1.)

The insect was placed in a small, elongated vial, so that I might easily observe and exhibit the display of lights. The light was brilliant until 11 P.M. on the night of September 27. At 2 A.M. the 28th the phosphorescence had disappeared. It did not appear again until the night of the 30th, when, by disturbing the insect, the lights began to glow, but continued only for a few hours. For a few nights within the space of a week I observed that the insect glowed only when disturbed. After that the posphorescence reappeared, and I do not believe once disappeared again until it was placed in alcohol, June 16, 1887.

October 1, 1886, I placed it in a glass jar of earth. It made a cell in the earth next the side of the jar, where I could observe the phosphorescence, and where it remained (excepting one warm day in February, 1887, when it came to the surface, and

returned at night when I placed the jar in a cooler place in my room) coiled up until the 15th of April. At that time the luminosity was becoming more brilliant and the brown color was disappearing, to be replaced by a uniform cream color.

I removed the earth from above the cell and took the insect in my hand. It immediately straightened and began crawling. When placed in the jar it sought its cell and there remained. Instead of returning the earth I placed a glass over it, so that I might observe the beautiful display of light It was so strong that I could read print by it when the letters were one-eighth inch long. About the 1st of May it cast its skin and became of a uniform cream color, lighter on the sides and ventral surface and between the segments of the dorsum.

Every night it came from its cell and wandered about the jar, probably striving to attract its mate. May 8 I took it out of doors at night, and placed it on the ground for about fifteen minutes. Nothing was attracted. Twice I took it in the daytime,—the 10th and 12th of May,—but nothing was attracted.

May 19 I placed it, with another (collected by Professor Holmes), in a large, open, glass jar, with about one inch in depth of earth. This I partly sunk in the earth in the open woods just at dusk. At nine o'clock the same evening I visited the place and saw a male within the jar. When it left its mate I caught it.[1] On the following morning I found another male outside the jar. The following night I captured two more males. During the day the females remained beneath the surface of the earth.

The luminosity in this case is decidedly of sexual significance, attracting the males at night. Mr. Rivers concluded that the luminosity of the female *Zarhipis riversi* was not of sexual significance, as males were attracted by day. He was at a loss to account for its utility.

Soon after meeting with the males the females became less active, and the luminosity, though plainly visible, was less in brilliancy. About June 4 they made each a cell in the earth and began depositing eggs. One deposited about twenty, and the other about thirty-five. The eggs are dull whitish in color, 3 mm. to 4 mm. in diameter. This, I believe, is the first instance on record of the eggs of any of the *Phengodini.* The female is coiled up in the cell while depositing the eggs, and afterwards lies coiled up on them. They are then very weak, and soon die. Can it be that the parent yields its dying or dead body as the first meal for its young? One which was found in September, 1886, was taken from the eggs when nearly dead and placed in alcohol. The eggs of this one proved infertile. The mouth parts, and especially the legs, were very much atrophied, and description was wellnigh impossible. In general appearance the adult is very much like that of the larva and pupa. The two

[1] Determined by Professor Riley as *Phengodes laticollis* Horn.

which I observed did not, however, resume the dark-brown color, but remained of a uniform pale-cream color, lighter on sides, under parts, and between the segments of the dorsum.

Occasionally during the adult state the one which I kept through the winter showed signs of luminosity on the prothoracic segment, but mainly shone as represented in Fig. 1. The other one exhibited no sign of luminosity on the pro- and meso-thoracic segments. Otherwise it was like Fig. 1. Professor Riley, seven years ago, figured a similar phosphorescent insect,[1] and in the paper, read before the Washington Entomological Society, he says that one found by him in 1869 was figured in Le Baron's fourth Illinois report.

The males are insignificant when compared to the females in size and beauty. They are 15 mm. to 20 mm. in length. Antennæ plumose, and half, or more than half, as long as the body. The elytra are short, thin, and subulate.—*Geo. F. Atkinson, University of North Carolina, Chapel Hill*, July 7, 1887.

ZOOLOGY.

The Irish Marine Fauna.—The *Proceedings of the Royal Irish Academy* (vol. iv. of the second series) contains two preliminary reports on the marine fauna of Ireland. One is by Prof. Alfred Haddon, and treats of the fauna of Dublin Bay. The other is the report of the Committee on the Marine Fauna of Southwestern Ireland, and gives an account of their explorations, the different groups being treated by specialists, in a manner similar to that adopted by the Liverpool committee. There is abundant room for similar work on the American shores, but the policy of centralization adopted by the United States Fish Commission has a discouraging effect.

Von Lendenfeld on Sponges.—Dr. R. von Lendenfeld has an extensive paper on the "Position and Classification of Sponges" in a recent part of the *Proceedings of the Zoological Society of London.* His views on most points are similar to those of Vosmaer. On account of the absence of a cœlom, he regards them as true members of the Cœlenterata,—a group which he divides into two phyla, Mesodermalia, embracing the sponges, and Epithelaria, including the true Cœlenterates of other authors. He regards the mesoderm of the sponges as a modification of the mesoglœa of the Cœlenterates, and homologous with it. His definition of the Mesodermalia is "Cœlenterata with permeating canal-system, and organs developed from the cells of the mesoglœa, or primary mesoderm. No movable appendages." This phylum has but a single class, Spongiæ, which is subdivided as follows:

[1] American Entomologist, vol. iii.; new series, vol. i., 1880, p. 202.

I. Sub-Class Calcarea.
  1. Order Calcispongiæ.
    i. Sub-Order Homocœla, with the families Asconidæ, Homodermidæ, and Leucopsidæ.
    ii. Sub-Order Heterocœla, with the families Syconidæ, Sylleibidæ, Leuconidæ, and Teichonidæ.

II. Sub-Class Silicea.
  1. Order Hexactinellida.
    i. Sub-Order Lyssacina, with the families Euplectellidæ, Asconematidæ, Rossellidæ, and Hyalonematidæ.
    ii. Sub-Order Dictyonina, with the families Farreidæ, Euretidæ, Melittionidæ, Coscinoporidæ, Tretodictyidæ, and Meandrospongidæ.
  2. Order Chondrospongiæ.
    i. Sub-Order Tetraxonia, with the families Rhizomorinidæ, Anomocladinæ, Tetracladinidæ, Corticidæ, Pachystrellidæ, Plakinidæ, Oscarellidæ, Geodidæ, Stellettidæ, Theneidæ, Tetillidæ, and Tethyopsyllidæ.
    ii. Sub-Order Monaxonida, with the families Tethydæ, Sollasellidæ, Spirastrellidæ, Suberamatidæ, and Suberitidæ.
    iii. Sub-Order Oligosilicina, with the families Chondrillidæ and Chondrosidæ.
  3. Order Cornacuspongiæ.
    i. Sub-Order Halichondrina, containing the families Spongillidæ, Homorhaphidæ, Heterorhaphidæ, Desmacidonidæ, and Axinellidæ.
    ii. Sub-Order Keratosa, with the families Spongidæ, Aplysinidæ, Hircinidæ, Spongelidæ, Aplysillidæ, and Halisarcidæ.

These families and major groups are all characterized, as are also the sub-families recognized. In each the more important genera are mentioned. The article concludes with a nearly exhaustive bibliography of the literature of recent sponges, no less than sixteen hundred and fifty-four titles being enumerated. The latest bibliography previous to this (that of D'Arcy Thompson, 1883) contained five hundred and fifty-one titles. In this connection the student should consult the *errata* given by Von Lendenfeld in the *Zool. Anzeiger*, No. 254.

Note on the Ctenidium of Unio aberti Conrad.—In January of the present year a gentleman resident in Kansas sent me several living specimens of *Unio aberti* Conrad, just then collected in Fall River, in that State. One of these specimens proved to be a female, the ctenidia of which were surcharged with developing young. It was particularly interesting, however, because of a modification of the branchial uteri, which has been hitherto noticed but once in any species of *Unio*.

Dr. Lea, in a paper read before the American Philosophical Society in early November, 1827, described both the shell and soft parts of *Unio irroratus*, a species then first made known. This paper was published, with figures, in vol. iii., *Transactions American Philosophical Society*, Plate V., 1827. The general physiological character of the ctenidium, as thus peculiarly modified, appears to have been fully understood by Dr. Lea, but its structural relation appears to have been misinterpreted and to have been regarded as an appendage of the branchiæ, and hence as being morphologically distinct. He thus writes, pages 270–271, *loc. cit.*: "In those I observed an appendage, in form of a depressed cone, attached to the branchiæ on either side, and a very slight examination fully satisfied me these were the oviducts. . . . The long sacks containing the ova are inserted about half-way up the branchiæ and somewhat posterior to the centre. The number of these sacks in my three specimens consists of eight in two and seven in the other." In Fig. 1 is given a copy of Mr. Lea's figure of this structure, seen in external view.

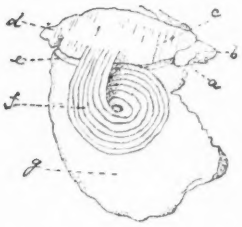


FIG. 1.—Explanation: "*a*, mouth; *b*, great anterior muscle; *c*, superior right branchiæ; *d*, great posterior muscle; *e*, inferior right branchiæ; *f*, right oviduct; *g*, foot."

Now, it is evident that these "sacks" instead of being appendages to, are really the elongated chambers of the ctenidia, functionally active as brood-pouches. The properly so-called oviduct of *Unio* is not well known, though the position of the genital opening leading from the gonads—whether they be ovaries or spermaries—is well known. The terms oviduct, as used by Mr. Lea, and ovaries, as commonly applied to the surcharged ctenidia, are, therefore, not only incorrect but misleading.

Hitherto the peculiar feature noticed in *Unio irroratus* has not been found in any other species in the genus, but it now finds an instructive counterpart in Conrad's species. As shown in Fig. 2, the anterior chambers of the ctenidium, *i*,—all of which are filled with young,—are directed ventrad and backwards in a flowing curve; but as the median chambers become filled they are recurved and thrown outwards. This recurving gives to the ctenidium the appearance which Mr. Lea described as a "depressed cone." The final result is an irregular intercoiling and crowding of the more posterior chambers, which are less than one-half the diameter of the anterior ones. The chambers are, without exception, very long cylindrical distally closed tubes, with a somewhat less diameter at point of origin than at extremity. Their walls, which are exceedingly thin and readily ruptured, are further somewhat protected by a transparent and

somewhat gelatinous membrane, which invests the entire ctenidium and serves to aid in holding the chambers in place.

In this specimen the young found in the anterior chambers were in a more advanced stage of development than were those in the most posterior chambers. It would appear that the ova are discharged through the genital opening into the innermost branchial cloaca and pass thence, being fertilized *in transitu* and moving with the cœlomic fluids, into the outer cloaca, whence they fill the chambers, often distending them to four and five times their normal diameter. Furthermore, in nearly if not quite all the species of *Unio* which have come under our personal observation, the anterior median chambers of the ctenidia appear to be first charged with ova. The process continues, successively extending towards the posterior extremity of the outer branchiæ until, in most if not all species, both nearly entire external ctenidia function as brood-pouches. My observation has been that the process of development is, to a certain degree at least, independent of temperature conditions, for I have taken specimens of *Unio* at all seasons of the year with the young in all stages of development.

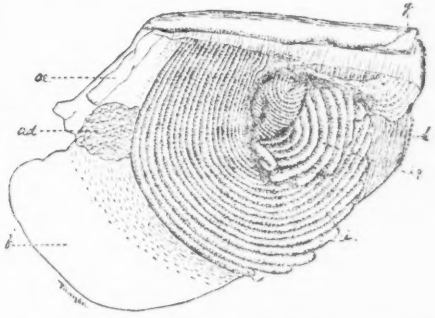


FIG. 2.—Explanation: *Oe*, œsophagus. The triangular labial palps have been removed. *ad*, anterior adductor muscle, in transverse section. *f*, foot. *i*, cylindrical chambers of the ctenidium. *ip*, excurved portion of medial chambers. *h*, siphonal tentacles. *g*, mantle, folded on itself above, to show junction of ctenidium.

It may not be out of place here to note that no byssus organ, such as is found in the glochidium larva of *Anodonta*, has ever been observed by me in the examination of numerous embryonic forms of many species of *Unio*. The byssus which is seen in certain related species—*e.g.*, *U. rubellinus*, *U. acutissimus*, *U. conradianus*, *U. parvulus*, and *U. penicillatus*—is gelatinous in nature and not chitinous, and lasts, at least in the Coosa and Cahawba Rivers, throughout the life of the individual.

An unfortunate duplication of species on the part of the writer ought, perhaps, to be mentioned here. In 1850, in *Proc. Phila. Acad. of Natural Sciences*, vol. v. p. 10, Mr. T. A. Conrad described *Unio aberti*, from the Verdigris River, Arkansas. The final description, with figures, appeared in the *Jour. Phil. Acad. Natural Sciences*, 2d series, vol. ii., Pl. XXIV., Fig. 1 (1851). Two

years later, in 1852, Dr. Lea described the same form under the name of *U. lamarckianus*, with figures, in the *Trans. Am. Phil. Soc.*, 2d series, vol. x., Plate XVII., Fig. 20. His figure is imperfect in that the characteristic roughened surface with more or less depressed folds is not shown, though mentioned casually, in the description. This circumstance, added to the fact that then I had not seen either the description or figure of Conrad's species, led me into the error of redescribing in 1885, as new, this same species under the name of *U. popenoi*, the specimens coming from the Fall and Verdigris Rivers, Kansas. *Vide* "Bulletin Washburn Coll. Lab. Nat. Hist.," vol. i. No. 2, pp. 48, 49, Pl. II., 1885. There is no reasonable doubt, however, but that the last described form is the female of *U. aberti*,—Conrad's description and figure being based upon the half-grown male form. The synonymy will therefore stand as follows: *Unio aberti*, Conrad (1850). *Unio lamarckianus*, Lea (1852). *Unio popenoi*, Call (1885). —*R. Ellsworth Call.*

Zoological News.—WORMS.—Miss A. M. Fielde, of Swatow, writes to the Philadelphia Academy (*Proceedings*, p. 115, 1887) describing some observations made on the life-history of a Chinese liver-fluke. One snail examined by her was the host of at least ten thousand young Distomæ, while another individual had the liver almost wholly replaced by a Redia of the same parasite.

Mr. A. G. Bourne gives (*Proc. Zool. Soc. London*, 1886 [1887]) a preliminary account of some Indian earth-worms belonging to the families Perichætidæ and Moniligastridæ. Eight belong to the genus Perichæta, one to Perionyx, and seven to Moniligaster. The species of Perionyx (*P. saltans*) has the power of leaping into the air when touched. Bourne says that the huge earthworm mentioned by Darwin as occurring on the Nilgherries turns out to be a species of Moniligaster described by Perrier as *M. deshayesii*.

The first part of the fourth volume of Bronn's "Klassen und Ordnungen der Thierreichs" has appeared. The volume will be written by Dr. A. Pagenstecher. The present part gives an historical account of the literature of Vermes, and contains three plates illustrative of the Dicyemidæ, the figures being taken mostly from the papers of Whitman and Van Beneden.

CRUSTACEA.—Bernhard Rawitz has a paper (*Arch. f. mikr. Anat.*, xxix.) on the green gland of the crayfish. The article treats wholly of histology, and contains no comparisons or morphological suggestions. The most important point brought out is that the gland consists, in reality, of two (not one) convoluted tubes, the two uniting a short distance behind the external opening of the common duct.

FISHES.—Miss Rosa Smith has described a new species of balloon-fish (*Tetraodon setosus*) in the *Bulletin of the California Academy* (vol. ii.). It is based on a dried skin brought from Mexico.

BATRACHIA.—At the meeting of the Zoological Society of London held June 7, 1887, Prof. G. B. Howes read a paper showing that in some of the anurous Batrachia there exists a structure which appears to correspond to the mammalian epiglottis, and which, in some species, becomes well developed as an organ of voice.

REPTILIA.—Prof. O. P. Hay gives (*Jour. Cincinnati Nat. Hist. Socy.*, x. pt. 2) a preliminary catalogue of the Batrachia and Reptilia of Indiana. Seventy-seven species are enumerated.

BIRDS.—W. E. Bryant publishes, in the *Bulletin of the California Academy of Sciences*, some additions to the ornithology of Guadeloupe Island. There were previously known but eight birds from this locality, but Mr. Bryant catalogues thirty-five species and sub-species.

The ostrich in the Cincinnati Zoological Gardens is dead. Mr. Charles Dury, in an account of the death, states that the bird broke its leg in an attempt to lay an abnormal egg. The ordinary ostrich-egg measures about five by six and one-quarter inches, but this one consisted of a normal egg as a centre, and around this there were about twenty leathery layers, the whole measuring about thirteen by eighteen inches.

MAMMALS.—Dr. Ch. Lütken, of Copenhagen, states that probably the habitat of the rare *Chiropodomys penicillatus* is Java, the Copenhagen Museum having received one in spirit from Bintenzorg. He also says, on the authority of Dr. H. Winge, that the city museum of Genoa has several specimens from the same locality.

F. E. Beddard publishes an account of the visceral anatomy and the brain of the Sondaic rhinoceros in vol. xii. of the *Transactions of the Zoological Society of London*. The only previous paper on the anatomy of this species was by the late Mr. Garrod.

The second "Cunningham Memoir" of the Royal Irish Academy is by Prof. D. J. Cunningham, and treats of the lumbar curve in man and apes, as well as of the topographical anatomy of the anthropoid apes. It is illustrated with thirteen plates, some of them colored.

A preliminary notice of a paper by Oldfield Thomas, on the "Homology and Succession of the Teeth in the Dasyuridæ," appears in No. 254 of the *Proceedings of the Royal Society*. In it the author presents an outline of a scheme of homology of the teeth, into which all mammals except the Edentates readily fit.

EMBRYOLOGY.[1]

The Development of an Eight-limbed Vertebrate.—It is now some months since I communicated my suspicions to several friends that the so-called fan-tailed race of gold-fishes (*Carassius*) represented a type with four pairs of ventral limbs. Within a few days, through the courtesy of friends, I have been the surprised recipient of an admirable memoir by S. Watase, of the Imperial University of Japan, entitled "On the Caudal and Anal Fins of Gold-fishes," in which the author gives a full account of the osteology and development of the frequently double anal and caudal of the breeds "Riukin" and "Maruko," as they are known to the Japanese.

The author shows that the embryos developed a series of double ventral limb folds extending from beneath the yelk-sac as far back as the end of the notochord and future urostyle. These folds being formed by an apparent median division of the ventral and caudal folds of the usual type seen in Teleostean embryos, the two resulting folds having shifted outwards somewhat from the median line towards the lateral position occupied by the rudiments of the anterior paired fins. This double or paired character of the ventral fold is also very pronounced in the preanal region, so that the two folds are serially continuous with the still more anterior rudiment of the "ventral" fin. The system of folds are entirely hypaxial, including even those which lead to the development of a double caudal, as in all Teleosts.

Tracing these very remarkable changes, Mr. Watase found that the interhæmal and the small basilar interhæmal nodules, supporting the rays of the anal and caudal, were repeated and paired the same as the folds in the embryos, and that even the hæmal arches of the caudal vertebræ were divergent from the median line instead of convergent towards it as in other Teleosts. In this manner both the anal and caudal paired fins are articulated by a chain of bones to the vertebral column. It is probable, however, that were the body cavity extended beyond the anus the anal pair would be severed from direct articulation with the vertebral column in the same way as the ventral or preanal pair, where the bones of the pelvic girdle represent, according to Wiedersheim, a pair of elements derived from a series of fused interhæmal pieces.

The supports of the caudal are morphologically of the same character. There can, therefore, be little or no doubt that it is quite proper to regard the pelvic, anal, and caudal pairs of fins, in the singularly modified domesticated races of gold-fishes, as serially of the same morphological value, and that if pectorals and ventrals are to be considered as limbs, the caudals and anals

[1] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania, Philadelphia.

must likewise, in this instance, be so considered. This type is the only vertebrate yet examined which possesses eight distinct appendages which may be legitimately considered as representing four pairs of limbs.

It is a singular circumstance that the ventral fin-folds in the embryos described by Mr. Watase are not double in the region of the anus. In every other respect these remarkable forms furnish confirmation of Dohrn's view as to the nature of the median ventral fin-fold of fishes.

Mr. Watase describes four principal types or modifications of the development of the paired fins of these interesting fishes. Upon the whole, his memoir is one of the most interesting in its bearings upon morphology of the limbs of fishes which has appeared for many years.—*John A. Ryder.*

The Inversion of the Germinal Layers in Hesperomys.—During the past summer the writer has succeeded in obtaining early stages of the embryos of *Hesperomys*, which show that the germinal layers of this American genus of myomorphs are "inverted" as in the mouse. Fig. 1 serves to show how closely they resemble the early stages of the latter as figured by Selenka. Here *s* represents the suspensor (*Träger*); *d*, the *Deckzellen*, or outer layer; *h*, hypoblast; *e*, the epiblast, of which only that portion as far as the constriction, *c*, enters directly into the formation of the embryo. At *a* is seen the amniotic part of the cavity enclosed by the epiblast, and at *f* the secondary cavity, which at a later period is separated from the cavity of the amnion. The attachment of the blastosphere at one end by means of processes of the cells forming the outer layer of the suspensor, *s*, is well marked, and the blastosphere, as in *Mus*, *Arvicola*, and *Cavia*, is very considerably elongated. The embryonic part of the epiblast, *e*, is also thrust inwards towards the bottom or fundus of the blastosphere so as to obliterate the cavity of the yelk-sac, as in the other genera named.

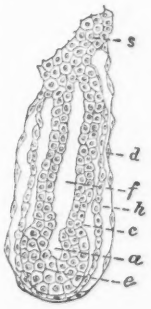


FIG. 1.

The relations of the blastosphere to the cavity of the uterus are also of some interest, as may be seen by reference to Fig. 2 (enlarged sixteen times), in which the greatly hypertrophied mucosa is represented at M, M, M, M in a cross-section of the uterus. Lying in an eccentric position in the section at *e* the minute embryo is apparent, while some distance from the embryo there is a hollow conical mass of tissue, *c*, which is part of the original epithelial wall of the tubular uterus, and is different from the much thickened and very spongy surrounding mucosa, the disposition of the lacunæ in which is indicated by the

faint radiating lines. The relations of the embryo, *e*, to the original cavity of the uterine tube is better shown in Fig. 3, showing a longitudinal section of a portion of the uterus containing a single embryo. The cavity of the uterus, *u*, *u*, at either side of the region containing the embryo, is quite spacious, whereas towards the centre, *c*, of the gravid portion its lumen has been narrowed to a fine canal. On the upper or mesometric side the mucosa, M, is thinner, while on the lower side the uterine wall is much more thickened. In fact, there is evidence to indicate that the embryo, *e*, has been thrust down into the lower wall and

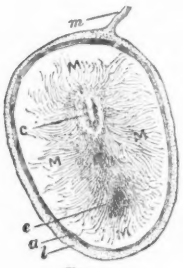


FIG. 2.

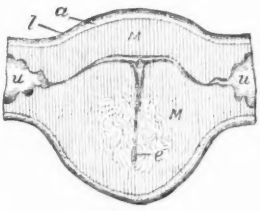


FIG. 3.

become imbedded in one of the crypts of the mucosa. That this is true is indicated by the conical or funnel-shaped passage, *c*, which leads down towards the embryo from the middle of the narrowed portion of the uterine cavity, as shown in Fig. 3.

The eccentric position of the embryo in the thickened mucosa, as well as the specialized condition of the blastosphere, would favor the development of a discoidal placenta, but that the discoidal type is not the one which was characteristic of the ancestors of the *Rodentia* is, it seems to the writer, sufficiently indicated by the annular thickening of the mucosa around the embryo, for, towards the non-gravid portions of the uterine cavity at *u*, *u*, the mucosa becomes suddenly thinner. As in man, the main portion of the uterus to be first affected is its mucous lining, the muscular wall undergoing a slower and less marked change. The inner annular and outer longitudinal muscular coats of the uterus are indicated at *a* and *l* in Figs. 2 and 3; the mesometrium at *m*. The annular structure described in the preceding number of this journal is not yet well differentiated at this stage.—*John A. Ryder.*

ANTHROPOLOGY.

The Discovery of an Ancient Tomb near the Holy Sepulchre, Jerusalem.—Early in October, 1886, excavations made on Christian Street, Jerusalem, resulted in the discovery of a tomb, evidently of great antiquity, far below the pavement. Christian Street is a narrow street running northerly and southerly, to the eastward of Hezekiah's Pool, and west of the Church of the Holy Sepulchre, connecting, at its northerly extremity, with the *Viâ Dolorosa*, which last is the traditional route traversed by Christ on his way to be crucified. The tomb is situated towards the east side of the street, and is exactly seventy-two feet due west from the Holy Sepulchre. It is two and one-half feet in height, and is of rude construction, the sides being formed of large stone slabs uncemented, while it is covered with similar slabs on top.

Soon after the unearthing of the tomb I was on the spot, and made as full an examination of it as the circumstances permitted; but the careless and clumsy work of the fellaheen had injured or destroyed much of the contents. I found the base of the tomb was fifteen and one-half feet below the surface of the street; and the section made by the excavation plainly showed that the original surface of the ground was a hill-side sloping in the direction of the Tyropœon Valley. The slope and depression were filled up with an accumulation of *débris* so as to be almost obliterated or made nearly level. The *débris*, composed of all sorts of rubbish of the ancient city, above the tomb amounted to four feet in thickness, but, of course, greatly increased towards the southward or lowest part of the slope. The base of the tomb was therefore eleven and one-half feet below the original surface of the hill-side, an unusual depth, which might be taken as implying great antiquity.

Within the tomb were found two interments, one being the much-decayed bones of a man, buried with the head to the west. The other was an instance of cremation, the remains being enclosed in a cinerary urn, and consisting of calcined bones mingled with ashes and charcoal. With these were lachrymal vases of terra-cotta, several of which were broken in the exhumation; but two were taken out unfractured. Though of rather graceful shape, they are of coarse make, and resemble each other in design, except that one is about one-third larger than the other, and is ornamented with four devices or figures (perhaps an inscription) in a dark (blackish) paint or stain, which in some places is barely traceable. The body of each vase is of oval outline, with flat bottom, and contracts into a long, taper neck, with trumpet-shaped mouth. The larger is a little over six inches, the smaller about four and one-third inches, in height. I was at once struck by their close resemblance to similar vessels

in collections in Jerusalem, which have been assigned to Phœnician origin, and to others brought from Cyprus; also to the more ancient of the Cypriote pottery which I had seen in the British Museum and the Louvre, as well as in the celebrated Di Cesnola collection in the American Museum, New York.

The cinerary urn, only the fragments of which have been seen by me, is of the same description of earthenware as the tear-bottles or vases, but is of a redder color. It is remarkably thin and fragile in proportion to its size, being about one-eighth of an inch thick.

All who have seen the tomb here described, and who are of experience in such antiquities, unhesitatingly assign it to the Canaanitish or Jebusite period. There can be no doubt as to its great age.

It is insisted on by many that this discovery largely favors the belief that the true sites of Calvary and the tomb of Christ are not those generally accepted, but are identical with the high knoll at the Cave of Jeremiah and the tomb in the garden near by, outside the walls of Jerusalem, near the Damascus Gate, they arguing that the Jews would never have selected as a place of interment a Jebusite or Canaanitish burial-place.

Though this may not be considered as conclusive, the facts here given may be regarded not only as interesting and valuable, but as forming an additional link in the chain of evidence slowly but surely encircling this important subject, and about which I shall have more to say anon, having accumulated thereupon much curious and determinative material, but with which I am not prepared to deal at present. Among the testimony I include the wonderful, massive, and extensive Roman pavements recently brought to light in this city, and which have bearings on the case of unquestionable and significant character.—*Henry Gillman, U. S. Consul, Jerusalem, Palestine.*

MICROSCOPY.[1]

Albuminized-Felt Tablets for Mounting Anatomical Preparations.—Anatomical preparations are usually exhibited mounted on plates of glass, wax, or wood, in alcohol. For many objects —*e.g.*, whole animals—glass plates are excellent mounting-tablets, but they do not serve this purpose well in the case of delicate preparations, such as the internal organs of insects, molluscs, etc. Wood or wax tablets are generally employed when the parts of the preparation require to be fixed in place by pinning; but these tablets are objectionable, inasmuch as they are attacked by alcohol.

[1] Edited by C. O. WHITMAN, Milwaukee, Wisconsin.

H. Dewitz[1] recommends felt tablets prepared in the following manner:

1. Pour the white of eggs, after separation from the yelks, into shallow plates, covering the bottom of each with a *thin* layer. Keep in a warm place for a few days, until the white becomes quite thick. If it is not to be used at once, let it dry completely, and then dissolve in cold water whenever needed.

2. Take a piece of fine, white wool-felt, of any desired size, and completely saturate it, by pressing and kneading, with the thickened (or dissolved) preparation of white.

3. Take two plates of thick window-glass, a little larger than the felt; warm them over a spirit-lamp, and smear one side of each with white wax,[2] rubbing the surface well with the finger in order to make the coat of wax thin and even. When the wax is cool, place the piece of albuminized felt between the glass plates, in contact with the waxed sides; and then bind them together with a string so closely that no layer of air is left between the felt and the layer of wax. Plunge the whole several times into boiling water (thus avoiding breakage through too rapid expansion); then leave it in the water (kept boiling) for a quarter of an hour. After cutting the string the glass plates are easily removed, leaving the felt tablet ready for cutting to the size and shape required.

4. The tablets thus prepared should be kept in ninety-five per cent. alcohol. Before use they may be soaked a few hours in water, in case they are too hard for the use of quills or spines as pins. It is not advisable to use the tablets immediately after boiling, as they only attain a proper degree of hardness after lying several days in ninety-five per cent. alcohol.

Colored tablets may be made by mixing coloring-substances with the prepared white. It is necessary, however, to select for this purpose substances that do not lose their color in alcohol. Lampblack may be used for black, ochre for yellow, cinnabar and vermilion for red.

The white tablets present a better appearance if they are treated with corrosive sublimate before being placed in ninety-five per cent. alcohol. The finished tablets may be stained with hæmatoxylin; but they must first be placed in boiling water to free them from any traces of wax. The stain with hæmatoxylin is often imperfect, and is therefore not to be recommended. Dewitz prefers ochre to any of the other coloring-substances above named.

After saturation with colored white it is well to sprinkle the tablet with the coloring-powder, and rub it in with the finger before bringing the tablet between the glass plates.

The foregoing method of procedure may be varied so as to

[1] Zool. Anz., x., No. 256, p 392, 1887.

[2] Instead of wax, a thin layer of collodion may be used.

give the white a leathery consistency. After the piece of felt has been thoroughly saturated with colored white and sprinkled freely with the coloring-powder, as before described, it is spread out on a clean glass plate and pressed down so as to leave no air-bubbles between it and the glass. It is then left to dry at ordinary room temperature. When completely dry it is removed from the glass and covered with a thin collodion solution. As soon as the collodion coat is dry the tablet is thrown into boiling water and kept below the surface by weighting for fifteen minutes. Black tablets colored with lampblack should always be made in this way, as they generally appear flecked when made by the first method.

The Reduction of Chromic Solutions in Animal Tissues corrected by Reoxidation with H_2O_2.—It is well known that the brownish-green color assumed by animal tissues under exposure to chromic solutions is due to a combination of the oxide of chromium (Cr_2O_3) with CrO_3. There is a partial reduction of the chromic acid in the tissues, resulting in the formation of Cr_2O_3, which then unites with the remaining CrO_3, to form the compound known as chromic chromate (chromsaure Chromoxyd). P. G. Unna[1] has shown that the greenish color can be removed by treating the tissues with hydrogen dioxide.

Unna explains the chemical processes involved in the following manner: "If a solution of chromic acid or bichromate of potassium be mixed with a solution of H_2O_2, a deep green precipitate of chromoxide (Cr_2O_3) is immediately formed, which combines with the remaining chromic acid to form the intermediate salt (chromic chromate) with a brownish-green color. If the mixture is left to itself, the process of reduction, after reaching a definite point, changes to one of oxidation, and the chromic chromate is soon reoxidized, leaving the solution yellow as at first. . . .

"The same phenomenon is seen when (1) sections colored by chromic acid or bichromate of potassium are placed in H_2O_2, or when (2) sections treated with H_2O_2 are immersed in the chromic solutions. The sections at once become dark green, then brownish-green, and, finally, in the first case yellow, in the second colorless.

"If the sections, at the moment when the brownish-green color appears, are removed from the solution and thoroughly washed, the color of the chromic chromate, which is not unimportant for many histological details, remains fixed."

[1] Archiv f. mik. Anat., xxx., H. 1, p. 47, 1887; *Cf.* Monatsheft f. prakt. Dermat., ii. p. 31.

SCIENTIFIC NEWS.

—Dr. N. Archer Randolph, professor in the University of Pennsylvania, was recently drowned near Atlantic City, N. J., at the age of thirty-eight years. Professor Randolph had made a number of important original researches in the physiology of digestion, and much was anticipated from his future work in this direction. His loss is a serious one from every point of view; neither science nor the community could afford the sacrifice.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Thirty-Sixth Meeting of the American Association for the Advancement of Science was held at Columbia College, New York, commencing Wednesday, August 10, and closing Tuesday, August 16, 1887.

The officers for the meeting were:

PRESIDENT.—S. P. Langley, of Washington. VICE-PRESIDENTS.—A. *Mathematics and Astronomy*—(William Ferrel, of Washington, was not present.) Vacancy filled. B. *Physics*—W. A. Anthony, of Ithaca, N. Y. C. *Chemistry*—Albert B. Prescott, of Ann Arbor, Mich. D. *Mechanical Science*—Eckley B. Coxe, of Drifton, Pa. E. *Geology and Geography*—G. K. Gilbert, of Washington. F. *Biology*—W. G. Farlow, of Cambridge, Mass. H. *Anthropology*—D. G. Brinton, of Media, Pa. I. *Economic Science and Statistics*—Henry E. Alvord, of Amherst, Mass. PERMANENT SECRETARY.—F. W. Putnam, of Cambridge (office Salem, Mass.). GENERAL SECRETARY.—W. H. Pettee, of Ann Arbor, Mich. ASSISTANT GENERAL SECRETARY—J. C. Arthur, of Geneva, N. Y. SECRETARIES OF THE SECTIONS.—A. *Mathematics and Astronomy*—Henry M. Paul, of Washington. B. *Physics*—C. Leo Mees, of Athens, Ohio. C. *Chemistry*—C. F. Mabery, of Cleveland, Ohio. D. *Mechanical Science*—George M. Bond, of Hartford, Ct. E. *Geology and Geography*—(T. B. Comstock, of Champaign, Ill., not present.) W. F. Davis, Cambridge, Mass. F. *Biology*—J. Henry Comstock, of Ithaca, N. Y. H. *Anthropology*—(F. W. Langdon, of Cincinnati, Ohio, was not present.) Vacancy filled. I. *Economic Science and Statistics*—W. R. Lazenby, of Columbus, Ohio. TREASURER.—William Lilly, of Mauch Chunk.

The following papers were read Thursday, August 11:

SECTION C—CHEMISTRY.

On the constituents of wild-cherry bark; Frederick B. Power and Henry Weimar. On the fatty acids of the drying oils; L. M. Norton. The chemical composition of the juices of sorghum cane, in relation to the production of sugar; H. W. Wiley. Percentage of ash in human bones of different ages; William P. Mason. On the occurrence in nature of a copper antimonide; T. H. Norton. A new apparatus for fractional distillation; T. H. Norton. Certain alloys of calcium and zinc; T. H. Norton. Amount of moisture left in a gas after drying with phosphorus pentoxide; Edward W. Morley. Improvement in stand for electrolysis; William Hale Herrick. A process for the separation of alkaloidal poisons, for students' use; Arthur L. Green. Causes, progress, and cure of recent great outburst of typhoid fever at Mount Holly, New Jersey; Albert N. Leeds. Some higher homologues of cocaine; F. G. Novey.

SECTION E—GEOLOGY AND GEOGRAPHY.

On the different types of Devonian in North America; H. S. Williams. The Trenton Limestone as a source of petroleum and inflammable gas in Ohio and Indiana; Edward Orton. Section of well at Morrisville, N. Y.; Charles S. Prosser.

The Upper Hamilton group of Chenango and Otsego Counties, N. Y.; Charles S. Prosser. A geological section at Great Barrington, Mass.; Alexis A. Julien. The granite and quartzite contact at the Aurora mine, Gogebic iron range, Ironwood, Mich.; N. H. Winchell. The Potsdam Sandstone in Southern Pennsylvania; J. Edgar. On the geology of New York City and environs; D. S. Martin. On recent field work in the Archæan of Northern New Jersey and Southeastern New York; N. L. Britton. On the age of the limestones of Westchester County, N. Y.; Frederick J. H. Merrill. Notes on the eruptive rocks of the Archæan in the New York and New Jersey Highlands; J. F. Kemp. Geological section of Southwestern Ohio; Joseph F. James. Notes on the Berea grit in Eastern Ohio; H. P. Cushing. The unknown geology of Illinois; T. B. Comstock. Notes on the Texas section of the American Cretaceous; Robert T. Hill.

SECTION F—BIOLOGY.

(No Zoological Papers were presented at the morning session; and no Botanical Papers at the afternoon session.)

Notes on the Flora of the Kittatinny Mountains; N. L. Britton. The cultivated Cinchonas of Bolivia; H. H. Rusby. Developments of the Umbellifer fruit; John M. Coulter. On the structure of the frond in *Champia parvula* Harv.; Robert P. Bigelow. Apical growth in Fucus; W. G. Farlow. Study of the hairs in *Silphium perfoliatum*, and *Dipsacus laciniatus* in relation to insects; W. J. Beal and C. E. St. John. Characters of the injuries produced by parasitic fungi upon their heart plants; A. B. Seymour. Notes on Catalpa leaf spot disease; Effie A. Southworth. Æcidium on *Juniperus virginiana;* W. G. Farlow. On the Phengodini and their luminous larviform females; C. V. Riley. On the morphology of the legs of hymenopterous insects; A. J. Cook. The mechanical origin of the sectorial teeth of the Carnivora; E. D. Cope.

SECTION H—ANTHROPOLOGY.

Aboriginal New York villages; W. M. Beauchamp. Recent archæological investigations in the Champlain Valley; G. H. Perkins. Study of a small and isolated community in the Bahama Islands; T. Wesley Mills. On the correlation of certain mental and bodily conditions in man; Charles Porter Hart. What is it? E. W. Claypole. Illustrative notes concerning the Minnesota Odjibways; Miss F. E. Babbitt. China in America; a study in the social life of the Chinese in the Eastern cities of the United States; Stewart Culin. The Serpent Mound of Adams County, Ohio, and its preservation by the Peabody Museum; F. W. Putnam. System of symbols adapted for American Prehistoric Archæology; Wills De Hass.

Evening.—General Reception to the members of the Association and their families by the Ladies' Committee, at nine o'clock, in the Metropolitan Opera House.

Friday, August 12.

SECTION C—CHEMISTRY.

Report of committee on uniform method of stating the results of analysis of mineral and potable waters.

Improvement in stand for electrolysis; William Hale Herrick. On the determination of nitrogen by soda lime; W. O. Atwater. Analysis of two manganese mineral waters; Fred. G. Novy. Standardizing hydrometers; W. P. Mason. On the salts of benzene-sulphonic acid with the amines; T. H. Norton. Some new metallic salts of benzene-sulphonic acid; T. H. Norton. On the amine salts of paratoluene-sulphonic acid; T. H. Norton. On the action of silicon fluoride on acetone; T. H. Norton. On the limits of the direct bromination of acetone and on the action between ammonium sulphocyanide and monobrom-acetone; T. H. Norton. On the action of chlorine on acenaphthene; T. H. Norton. On the urates of ammonium and the amines of the fatty acids; T. H. Norton. Some new nitroprussides; T. H. Norton. Composition of Lockport sandstone; H. W. Weld. Note on the chemistry of germination; Wm. McMurtrie. Note on absorption of nitrogenous nutriment by the roots of plants; Wm. McMurtrie. The processes of soil formation

from the Northwestern basalts; E. W. Hilgard. Indirect determination of calcium; William Hale Herrick. On the delicacy of the sense of taste; E. H. S. Bailey and E. L. Nichols.

SECTION E—GEOLOGY AND GEOGRAPHY.

This morning was devoted to a consideration and discussion of the report of the American Committee of the International Congress of Geologists, which was read by Dr. Persifor Frazer, Secretary. In the course of the discussion Major J. W. Powell, director of the United States Geological Survey, endeavored to have the committee enlarged, but was not sustained. A resolution approving its work was adopted.

SECTION F—BIOLOGY.

On the physiology of the heart of the snake; T. W. Mills. Remarks on classification; B. G. Wilder. On the morphology of the skull and the evolution of the Ichthyopterygia; G. Baur. Locomotion and bilateral symmetry; Joseph Jastrow. Remarks on the development of Pteromyzon; W. B. Scott. On the morphology of the ribs; G. Baur. Observations upon the embryological development of the opossum; H. F. Osborn.

SECTION H—ANTHROPOLOGY.

History and present condition of Pre-historic Archæology in Western Europe; Thomas Wilson. Relics of an Indian hunting-ground; A. Wanner. On a gigantic jadeite votive adze from Oaxaca, Mexico; George F. Kunz. On a remarkable crystal skull; George F. Kunz. Some aboriginal dwelling sites in the Champlain Valley; D. S. Kellogg. The true basis of ethnology; Horatio Hale. On the assumed mythical character of Prof. Heer's Atlantis theory; J. Kost.

Afternoon.—At the request of Mrs. J. S. T. Stranahan, of Brooklyn, the directors of the Union Ferry Company invited the members of the American Association for the Advancement of Science to an excursion around the harbor of New York. The ferry-boat "Brooklyn" left South Ferry, and returned to same place between 6 and 7 P.M.

Evening.—The sections met at eight o'clock. Reception of the Botanical Club of the Association by the Torrey Botanical Club, in the Library Hall of Columbia College. The herbarium was open for inspection, and a collation was served in the basement of the Law School.

Saturday, August 13, an excursion up the Hudson River, to West Point, left at 9 o'clock A.M., by the steamer "New York" of the "Albany Day Line." An excursion to Long Branch started at 10 o'clock A.M., upon one of the Iron Steamboat Company's steamers, and returned at 8.30 P.M.

Monday, August 15.

SECTION C—CHEMISTRY.

The significance of "bonds" in structural formulas; Spencer B. Newberry. Positive and negative units of valence; Albert B. Prescott. On chemical changes accompanying osmose in living organisms as illustrated by the oyster; W. O. Atwater. The processes of soil-formation from the Northwestern basalts; E. W. Hilgard. A new method for the preparation of anhydrous aluminium chloride; C. F. Mabery. The action of aromatic amines upon certain substituted unsaturated acids; C. F. Mabery. Constitution of the sulphur compounds in crude petroleum oils (preliminary notice); C. F. Mabery. A compound rich in carbon occurring in some plants;

Helen C. De S. Abbott. The scientific basis of the feeding of infants; Albert R. Leeds. Report of Committee on Indexing Chemical Literature.

SECTION E—GEOLOGY AND GEOGRAPHY.

Section of the Lower Silurian (Ordovician) and Cambrian strata in Central New York, as shown by a deep well near Utica; C. D. Walcott. Notes on the geology of Florida; L. C. Johnson. The Upper Eocene lacustrine formations of the United States; W. B. Scott. "Lake Cuyahoga," a study in glacial geology; E. W. Claypole. The southern drift; Joseph E. Willet. Notes on the extinct thermal springs of Arkansas; Theo. B. Comstock. Sand-boulders in the drift, or subaqueous origin of the drift in Central Missouri; J. W. Spencer. Notes on the theory of glacial motion; J. W. Spencer. Glacier erosion in Norway, with some notes on northern ice-action; J. W. Spencer. The Columbia formation; W. J. McGee. The origin of the terraces along the Ohio River between Cincinnati and Louisville; John C. Branner. The southern limit of the glacial drift in Kentucky and Indiana; John C. Branner. Genesis of the Hawaiian Islands; C. H. Hitchcock. A description of two caverns near Manitou, Colorado, with maps; H. C. Hovey. Photographs of the interior of a coal mine; Fred. P. Dewey. On the monticuliporoid corals of the Cincinnati group, with a critical revision of the species; Jos. F. James and U. P. James. Discovery of fossils in the lower Taconic of Emmons; Chas. D. Walcott.

SECTION F—BIOLOGY.

The Cultivated Cinchonas of Bolivia; H. H. Rusby. Æcidium on *Juniperus virginiana;* W. G. Farlow. A comparison of the Epidermal System of different plants; W. J. Beal. Confirmatory evidence of *Mastodon obscurus* Leidy, as an authentic American species; R. P. Whitfield. The Buffalo-gnat problem in the lower Mississippi Valley; C. V. Riley. Origin of American Carnivora; W. B. Scott. A point in dermal physiology; with demonstration of a new æsthesiometer; Joseph Jastrow. The relation of the commissures of the brain to the information of the encephalic vesicles; H. F. Osborn. The pineal eye in extinct Vertebrata; E. D. Cope. Preliminary paper on structure of *Alosa sapidissima;* Fanny R. Hitchcock. On the homologies of Edestus; Fanny R. Hitchcock. On the early history of the foot in Prosobranch Gastropods; Henry L. Osborn.

SECTION H—ANTHROPOLOGY.

The true basis of ethnology; Horatio Hale. Sensory types of memory and apperception; Jos. Jastrow. Music and poetry of the Eskimos; F. Boaz. The Palæolithic age in America; S. D. Peet. The subdivision of the Palæolithic period; D. G. Brinton. The Indians of British Columbia; F. Boaz. Totemism and animal worship; was it confined to the races who were in the hunter stage? S. D. Peet. The Serpent Mound of Adams Co., O.; F. W. Putnam. On the preservation of Aboriginal remains in America; Alice C. Fletcher.

Afternoon.—A botanical excursion to Sandy Hook gave the botanists of the Association an opportunity to examine the seaside flora, in company with the Torrey Botanical Club and the Natural Science Association of Staten Island. The Entomological Club accompanied the Botanical on this excursion.

Evening.—Reception by the Academy of Sciences.

At eight o'clock, a meeting of the NEW YORK ACADEMY OF SCIENCES was held in the Library Building of Columbia College, for the especial purpose of welcoming the Association.

Professor Henry Drummond, of Glasgow, delivered a lecture on "The Heart of Africa," giving observations on a recent scientific tour to the region of the Zambesi and Lake Tanganyika.

After the lecture a general reception and a collation was given to the members of the Association and their families by the Academy.

The Electric Club of New York City generously tendered the

privileges of their club-house for two weeks to the members of Sections B, C, and D.

For Wednesday, an invitation was extended by the Right Rev. Bishop Potter, to those members who desired to visit the Public Institutions on Blackwell's Island.

A geological party, under the direction of Mr. George Kunz, visited the trap and sandstone exposures of the Palisades and Bergen Ridge. On their return, the party were entertained by Mr. and Mrs. Kunz at their house in Hoboken.

Lieutenant E. L. Zalinski, Fifth U. S. Artillery, invited those members who are interested in Mechanics and Physics to witness the firing of the "pneumatic" (dynamite) gun, at Fort Lafayette, on Wednesday afternoon.

The Excursion Committee was authorized by Mr. Henry Monett, Gen. Pass. Agt., to extend in behalf of the New York Central & Hudson River Railroad Co., an invitation to those attending the Association to visit Saratoga at a nominal rate.

Tuesday, August 16.

SECTION E—GEOLOGY AND GEOGRAPHY.

Discovery of fossils in the lower Taconic of Emmons; Chas. D. Walcott. The plants and the fishes of the triassic rocks of New Jersey and the valley of the Connecticut; J. S. Newberry. The fossil fishes of the Cleveland shale; J. S. Newberry. The State Line Serpentine and associated rocks, a preliminary notice of the Serpentines of S. E. Pennsylvania; Fred'k D. Chester. Exhibition of a new petrographical microscope of American manufacture; George H. Williams. Some examples of the dynamic metamorphism of the ancient eruptive rocks of the south shore of Lake Superior; George H. Williams. The "Huronian" system; Alexander Winchell. Is there a diamond field in Kentucky? J. S. Diller and Geo. F. Kunz. Mineralogical notes. On the diamond found at Dysartville, N. C. Rock-crystal from Ashe Co., N. C.; Geo. F. Kunz. On the agatized and jasperized wood from Chalcedony Park, Arizona, with exhibition of magnificent specimens; Geo. F. Kunz. The relation of the pole of the land hemisphere to continents, to the magnetic system, and to seismic force; Richard Owen. Relation between geographical forms and geological formations; Richard Owen. The "slate conglomerate" of the original Huronian, the parallel of the Ogishke conglomerate of Minnesota; N. H. Winchell. The Animike black slate and quartzite and the Ogishke conglomerate of Minnesota, the equivalent of the original Huronian; N. H. Winchell. An unconformable conglomerate lying on the Marquette iron-ore rocks at Negaunee and Ishpeming, Michigan; N. H. Winchell. On the successful protection of the Egyptian Obelisk in Central Park, against the ravages of two winters, by saturating its surface with melted paraffine wax; R. Ogden Doremus. A geological section of Great Barrington, Mass.; Alexis A. Julien. The four great sandstones of Pennsylvania; E. W. Claypole. The Trenton limestone as a source of petroleum and inflammable gas in Ohio and Indiana; Edward Orton. The unknown geology of Illinois; Theo. B. Comstock. Notes on the extinct thermal springs of Arkansas; Theo. B Comstock.

SECTION F—BIOLOGY.

On the histology of the vegetative organs of *Brasenia peltata* Pursh; J. Schrenk. The flora of the Amboy clays; J. S. Newberry. Honey plant oil; F. S. Pease. The honey plant; Mrs. F. S. Pease. The flora of the Potomac formation in Virginia; William M. Fontaine. Methods of branching in the fibro-vascular system of plants; A. A. Crozier. Some notes on American roses; Sereno Watson. The proboscis of the mosquito; G. Macloskie. On cataloguing microscopical preparations; R. H. Ward. On the origin, development, and prevalency of the so-called Echinococcus; C. P. Hart.

SECTION H—ANTHROPOLOGY.

On the Santhals of Northeastern Bengal; S. Kneeland. Anthropology as a study in a college course; G. H. Perkins. Some of the unsolved problems connected with the stone age, especially as to its subdivision; S. D. Peet. The Niam Niams and their neighbors; Franz Boas. Evidences of a pre-Indian occupation of New Jersey; Charles C. Abbott. Some aboriginal dwelling sites in the Champlain Valley; D. S. Kellogg. The relation of archæological remains to river terraces; A. W. Butler, Preliminary studies of Platycnemic Tibiæ; Frank Baker. The philosophy of wit, humor, and satire; Melville D. Landon.

PROCEEDINGS OF THE GENERAL SESSION—Mr. J. A. Brashear, of Allegheny, Pa., brought the following voluntary contributions from friends in Pittsburg, Pa.:

William Thaw.....One hundred dollars.
C. G. Hussey.....One hundred dollars.
George Westinghouse, Jr.....Fifty dollars.
Henry Phipps, Jr.....Fifty dollars.

The following resolutions were adopted by the Association:

(1) Memorializing Congress to preserve archæological remains on public lands from destruction.

(2) Memorializing the Executive to appoint at an early day an efficient chief of the United States Coast Survey.

(3) Appointing a committee to obtain from Congress a reduction on the tariff on scientific books and apparatus.

(4) Memorializing Congress for the establishment of a bureau of standard measurements.

(5) Recognizing the importance of printing the compilation of the literature of meteorology prepared by the Signal Office.

(6) Approving and endorsing the project for erecting a monument over the remains of J. J. Audubon in New York City.

(7) Expressing regret that an invitation to meet in Toronto next year was received too late for acceptance.

The following committees were appointed:

(1) On awards of pecuniary aid for scientific research.

(2) To transmit to the Executive the resolutions relative to the United States Coast Survey.

(3) A permanent committee on transportation for the Association.

The following officers were elected to serve at the next meeting:

President, Major J. W. Powell, of Washington. *Vice-Presidents by Sections:* Mathematics and Astronomy, Professor Ormond Stone, of the University of Virginia; Physics, Professor A. A. Michelson, of Cleveland, Ohio; Chemistry, Professor C. E. Monroe, of the United States Navy, Newport, R. I.; Mechanical Science, Professor C. W. Woodward, of the Washington University, St. Louis; Geology and Geography, Professor G. H. Cook, New Brunswick, N. J.; Biology, Professor C. V. Riley, Washington; Anthropology, Professor Charles C. Abbott, Trenton, N. J.; Economic Science and Statistics, Professor C. W. Smiley, Washington. *Permanent Secretary*, Professor F. W. Putnam, Cambridge. *General Secretary*, Professor J. C. Arthur, Lafayette, Ind. *Secretary of the Council*, Professor C. Leo Mees, Athens, Ohio. *Treasurer*, William Lilly, Mauch Chunk. *Secretaries of Sections in Order*, Professor C. L. Doolittle, Bethlehem, Pa.; Dr. A. L. Kimbal, Johns Hopkins University; Professor W. L. Dudley, Nashville; Professor George H. Williams, Johns Hopkins University; Professor Arthur Beardsley, Swarthmore College; Dr. N. L. Britton, Columbia College; Professor Frank Baker, Smithsonian Institution; and Professor Charles S. Hill, Washington.

The place for the next meeting was settled to be at Cleveland, and the date will be the fourth Wednesday in August, 1888.